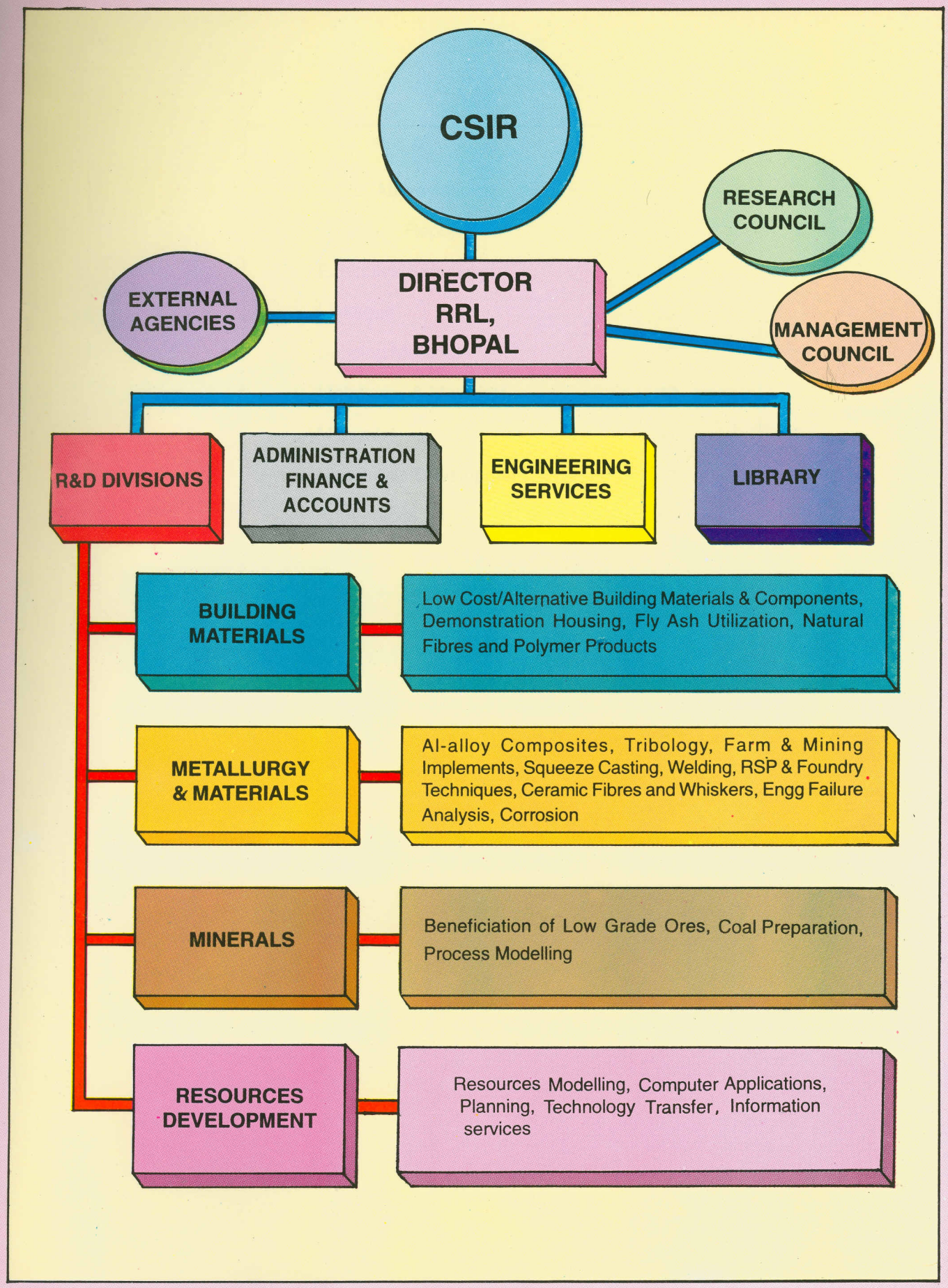
ANNUAL REPORT 1994-95

REGIONAL RESEARCH LABORATORY
BHOPAL-462 026

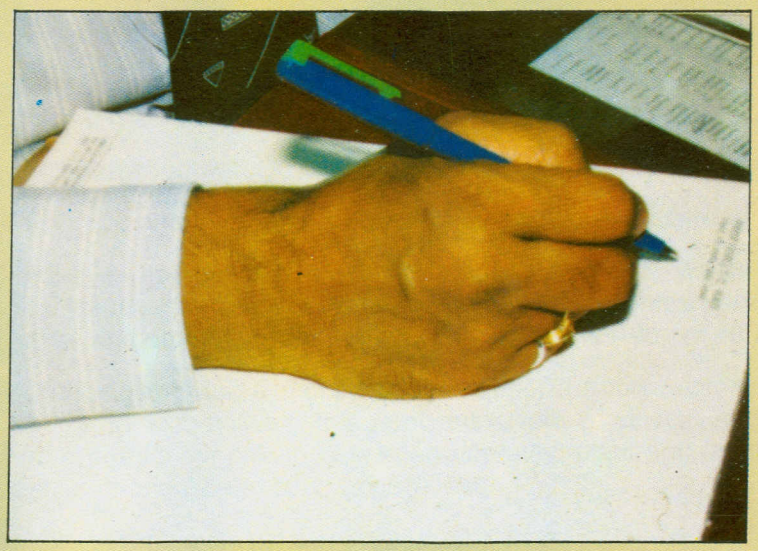
Organization Chart



LIST OF ABBREVIATIONS USED

AACL	Atlas Automotive Components Limited
BHEL	Bharat Heavy Electricals Limited
BMTPC	Building Materials Technology Promotion Council
BZL	Bharat Zinc Limited
CBIP	Central Board of Irrigation and Power
CGWB	Central Ground Water Board
CIAE	Central Institute of Agricultural Engineering
CMPDIL	Central Mine Planning and Design Institute Limited
CPWD	Central Public Works Department
CSIR	Council of Scientific and Industrial Research
DAE	Department of Atomic Energy
DMRL	Defence Metallurgical Research Laboratory
DST	Department of Science and Technology
HUDCO	Housing and Urban Development Corporation
HZL	Hindustan Zinc Limited
IBM	Indian Bureau of Mines
ICAR	Indian Council of Agricultural Research
IISc	Indian Institute of Science, Bangalore
ISM	Indian School of Mines, Dhanbad
ISRO	Indian Space Research Organisation
NABARD	National Bank for Agricultural and Rural Development
NBO	National Building Organisation
NMDC	National Mineral Development Corporation
NTPC	National Thermal Power Corporation
OCL	Orient Cerawool Limited
OTL	Optel Telecommunications Limited
MOUD	Ministry of Urban Development
MPCOST	M.P. Council of Science & Technology
MPSMC	M.P. State Mining Corporation
PHED	Public Health Engineering Department
PWL	Permali Wallace Limited
RDSO	Railways Design and Standards Organisation
RGMWD	Rajiv Gandhi Mission for Watershed Development
RRL	Regional Research Laboratory, Bhopal
SECL	South Eastern Coal Fields Limited
TADA	Tawa Ayacut Development Authority
TISCO	Tata Iron & Steel Company
VRDE	Vehicle Research & Development Establishment

Director's Report



Following have been the significant developments at RRL, Bhopal during 1994-95:

- efforts to functionalise products and processes developed by the laboratory through active association of user industries and agencies;
- building up a vibrant interaction with Govt. of M.P. on S&T input to regional problems; and
- consolidating the scientific and technological capabilities and infrastructure.

The laboratory sustained an appreciable level of external cash-flow of Rs.132.00 lakh, and more importantly, over 80% of the recurring expenditure, leading to overall technical performance and growth. This level of performance was possible with a total staff of 128, comprising of 48 scientists (Gr. IV).

Significant amongst technology/product developments have been the fibre reinforced plastic (FRP) gear cases for traction motors of locomotives, the wood substitute products, introduction of washing techniques like Vorsyl Separator for coking coal in an operating plant and metal matrix composites (MMCs) for automotive components and other applications.

FRP gear cases have undergone over ten months of field trials in South-Central Railway. M/s Permali Wallace Ltd., Bhopal have been assigned this technology for commercial production. Building Materials Technology Promotion Council (BMTPC) is guiding the efforts of marketing the wood substitute products developed by RRL. Prompted by the success of Vorsyl Separator installed by TISCO at its West Bokaro Washery, the laboratory has attracted more projects in this area which aim at eventual industrial application of the technique. Similarly, ceramic fibres preforms, MMCs brake drums, modified mining implements, farming implements, and tribo-components developed by RRL have been subject to elaborate performance evaluation and field applications with encouraging results. A project on "Fertilizer Minerals of M.P." supported by Department of Mines has been completed and a detailed project report with techno-economic assessment is available.

Pilot project on wasteland development through fly ash utilisation at NTPC, Rihandnagar, is nearing successful completion. The project has provided a strong basis for embarking on projects related to bulk utilisation of fly ash in land reclamation at other sites in vicinity of power plants in the country.

CSIR and RRL's aspirations regarding S&T input to regional development got a major filip when a meeting of Dr. S.K. Joshi, DGSIR, with the Chief Minister, Shri Digvijay Singh and senior officials of M.P. State Govt. was held on November 14, 1994. Subsequently the laboratory is helping in coordination and tie-up of CSIR laboratories with the Rajiv Gandhi S&T Missions launched in M.P. Major inter-lab

collaboration is expected with NEERI, CLRI, CBRI and IICT with reference to Watershed M Advanced Technology Mission and Rural Industries Mission of the State Govt. RRL has in activities in environmental studies with specific reference to local needs.

Involvement of a host of agencies such as State Govt., UNICEF and NABARD in the proje groundwater resources management is an indicator of the interest evoked by RRL in this vita RRL is associated with the Rajiv Gandhi Watershed Development Mission in carrying out prepa of watershed maps and thematic maps.

Major activities related to research support and technical advice were undertaken for State Ele Boards, industries and other agencies. These included specialised technical services in ter materials evaluation and characterisation, engineering failure analysis, and component life exte studies. A Centre for Characterisation of Building Materials, being set up with the support from BM DST and CSIR, has already started attracting a variety of materials evaluation assignments proposed to seek accreditation to this centre from DST.

Six agreements for collaborative projects and technology transfer have been signed during the four of these agreements are with prestigious industries around Bhopal, namely M/s Permali Wa Ltd., M/s Bharat Zinc Ltd., and M/s Elcaps Ltd.

RRL arranged a "National Workshop on Watershed Development" on February 24-25, 1995 unde auspices of Rajiv Gandhi Watershed Development Mission, Govt. of M.P. Shri Digvijay Singh, Minister, inaugurated this Workshop. RRL and Central Board of Irrigation and Power (CBIP) cond a two day Workshop on Fly ash Utilisation on January 11-12, 1995.

RRL was privileged to receive a large number of distinguished visitors. Prof. M.M. Sharma, Dire UDCT, Bombay and Member, CSIR Society delivered the CSIR Foundation Day (1995) lec Dr. S.K. Joshi, DGSIR presided over the valedictory function of 27th Shanti Swaroop Bhatn Memorial Tournaments hosted by RRL, Bhopal.

Many functional additions were made to the existing S&T infrastructure, particularly with a vie modernise and update the facilities. Several modifications in the laboratory buildings for additional s have been completed. CSIR has approved construction of residential colony in the campus.

A conscious effort was made to sustain high professional standards, through research publicat seminars and interactions with experts. A number of seminars and lectures by eminent scientists technologists provided an inspiring temper to the laboratory.

RRL records sincere appreciation of the support received from various govt. depts., agencies industry who have sponsored a large number of significant R&D projects. A close interaction with t has ushered in an era of meaningful R&D collaboration.

RRL, Bhopal is especially indebted to Dr. P. Rama Rao, Secretary, DST and Chairman, Rese Council, Dr. S.K. Joshi, Director General, CSIR, members of Research Council and Manage Council for providing directions to the R&D endeavour. The guidance received from CSIR Headqua has been very valuable to the laboratory.

Scientists and staff of RRL, Bhopal have put in hard and dedicated work towards development progress of the laboratory.

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Director's Report

वर्ष 1994-95 के दौरान क्षेत्रीय अनुसंधान प्रयोगशाला, भोपाल में निम्नलिखित महत्वपूर्ण परिवर्धन हुये:

- उपभोक्ता उद्यमों और अभिकरणों के सक्रिय सहयोग से प्रयोगशाला में विकसित उत्पादों और प्रक्रियाओं को कार्यान्वित करने के प्रयास;
- मध्य प्रदेश सरकार के साथ, क्षेत्रीय समस्याओं के लिए विज्ञान और प्रौद्योगिकी के निवेश के लिए प्रभावशाली परस्पर संवाद; और
- वैज्ञानिक एवं प्रौद्योगिकीय क्षमताओं और अवसंरचनाओं का संघटन।

प्रयोगशाला ने रु. 132.00 लाख के वाह्य कैश फ्लो के प्रशंसनीय स्तर को वनाए रखा और विशेष वात यह है कि यह राशि आवर्ती खर्च के 80 प्रतिशत से भी अधिक भाग होने के कारण तकनीकी और विकास कार्यों में गति आई। सभी 128 कर्मचारियों, जिनमें 48 वैज्ञानिक भी सम्मिलित हैं, के सहयोग से इस स्तर को वनाए रखना संभव हुआ।

विकसित महत्वपूर्ण तकनीकों/उत्पादों में मुख्य हैं: वाहनों के कर्षण मोटरों के लिए रेशा प्रवलित प्लास्टिक (फाइवर रेन्फोर्सड प्लास्टिक) गियर केस, काष्ठ विस्थापित उत्पाद, एक प्रचालित कोयला वनाने के संयंत्र में वोरासिल विलगक जैसी प्रक्षालन तकनीकों का विकास और वाहनों के संघटकों एवं अन्य अनुप्रयोगों के लिए धात्विक आधात्री सम्मिश्र (मेटल मैट्रिक्स कम्पोजिट)।

दक्षिण मध्य रेलवे में एफ आर पी गियर केसों का दस महीनों तक क्षेत्र परीक्षण हुआ है। मैसर्स परमाली वैलेस लि., भोपाल को इस तकनीक के व्यापारिक स्तर पर उत्पादन का काम दिया गया है। भवन निर्माण उत्पाद प्रौद्योगिकी प्रवर्धन परिषद (विल्डिंग मैटीरियल्स टैक्नोलॉजी प्रोमोशन काउंसिल), क्षे अ प्र द्वारा विकसित काष्ठ विस्थापित उत्पादों की विक्री के प्रयासों को निर्देशित कर रहा है। टिस्को के पश्चिमी वोकारो प्रक्षालित्र में स्थापित वोरासिल विलगक की सफलता से प्रेरित होकर, प्रयोगशाला ने इस दिशा में और भी परियोजनाओं को आकर्षित किया है जिनका उद्देश्य तकनीकों का अंततः औद्योगिक प्रयोग है। इसी तरह, क्षे अ प्र द्वारा विकसित सिरैमिक रेशों की वनी पूर्वसंरचनाओं, एम एम सी ब्रेक ड्रम, रूपांतरित खनन उपकरणों, कृषि उपकरणों, और ट्राइवो संघटकों का कार्य करने की क्षमता और वाजार में उपयोगिता की दृष्टि से विस्तृत मूल्यांकन किया गया जिसके उत्साहवर्द्धक परिणाम प्राप्त हुए। खदान विभाग के सहयोग से 'मध्य प्रदेश के उर्वरक खनिज' नामक परियोजना पूरी की गयी और तकनीकी-वित्तीय मूल्यांकन सहित एक विस्तृत रिपोर्ट उपलब्ध है।

एन टी पी सी, रिहन्दनगर में उड़न राख के उपयोग द्वारा व्यर्थ भूमि विकास पर एक आरंभिक परियोजना सफलतापूर्वक पूरी होने को है। इस परियोजना से, देश के अन्य ऊर्जा संयंत्रों के निकट क्षेत्रों में उड़न राख के उपयोग द्वारा भूमि सुधार से संवंधित परियोजनाओं को ठोस आधार मिला है।

14 नवम्वर, 1994 को मुख्य मंत्री श्री दिग्विजय सिंह और मध्य प्रदेश राज्य सरकार के वरिष्ठ अधिकारियों के साथ डा. श्री कृष्ण जोशी, डी जी एस आइ आर, की भेंटवार्ता से वै औ अ प और क्षे अ प्र के क्षेत्रीय विकास के लिए विज्ञान और प्रौद्योगिकी निवेश की आकांक्षाओं को प्रवल प्रोत्साहन मिला। इसके वाद से प्रयोगशाला, मध्य प्रदेश में आरंभ राजीव गांधी विज्ञान और प्रौद्योगिकी मिशन के साथ वै औ अ प की प्रयोगशालाओं, की सामंजस्य स्थापित करने और जोड़ने में सहायता कर रही है। राज्य सरकार के जल-अपवाह मिशन, उन्नत तकनीकी मिशन, और ग्रामीण उद्योग मिशन के संदर्भ में नीरी, सी एल आर आई, सी वी आर ई और आइ आइ सी टी से सर्वाधिक अन्तर-प्रयोगशाला सहयोग वांछनीय है। स्थानीय आवश्यकताओं के अनुसार, क्षे अ प्र ने पर्यावरण संवंधी अध्ययन आरंभ किये हैं।

भूमिगत जल संसाधन प्रवंधन संवंधी परियोजनाओं में राज्य सरकार, यूनीसेफ और एन ए वी ए आर डी जैसी संस्थाओं का सम्मिलित होना, इस महत्वपूर्ण क्षेत्र में क्षे अ प्र द्वारा उत्पन्न की गयी रूचि का परिचायक है। क्षे अ प्र, राजीव गांधी जल अपवाह विकास मिशन के अन्तर्गत तैयार किये जा रहे जल अपवाहक मानचित्रों और विषयक मानचित्रों से भी संवंधित है।

निदेशक का प्रतिवेदन

राज्य विद्युत बोर्ड, उद्यमों और अन्य संस्थाओं के लिए अनुसंधान सहयोग और तकनीकी सलाह देने जैसी मुख्य क्रियाएं भी कार्यान्वि की गयीं। इसके अन्तर्गत उत्पाद मूल्यांकन और अभिलक्षण, अभियांत्रिकी विफलता विश्लेषण, और संघटकों का जीवन विस्ता संबंधी अध्ययन जैसी विशेष तकनीकी सेवाएं आती हैं। वी एम टी पी सी, विज्ञान और प्रौद्योगिकी विभाग और वै औ अ प के सहयोग से स्थापित भवन निर्माण साम्रगी अभिलक्षण केन्द्र ने पहले से ही कई प्रकार के पदार्थ मूल्यांकन समनुदेशनों को आकर्षि करना आरंभ कर दिया है। इस केन्द्र के लिए विज्ञान और प्रौद्योगिकी विभाग से प्रत्यायन का प्रस्ताव है।

इस वर्ष के दौरान सहयोगी परियोजनाओं और प्रौद्योगिकी स्थानांतरण के छः अनुबंधों पर हस्ताक्षर किए गये, इनमें से चार अनुबं भोपाल के मैसर्स परमाली वैलेस लि., मैसर्स भारत जिंक लि. और मैसर्स एल्कैप्स लि. आदि प्रतिष्ठित उद्यमों के साथ हैं।

क्षे अ प्र ने राजीव गांधी जलअपवाह विकास मिशन, मध्य प्रदेश सरकार के तत्वाधन में 'जलअपवाह विकास पर राष्ट्रीय कार्यशाला का आयोजन फरवरी 24-25, 1995 को किया। मुख्य मंत्री श्री दिग्विजय सिंह ने इस कार्यशाला का उद्घाटन किया। क्षे अ प्र और केन्द्रीय सिंचाई और बिजली बोर्ड ने, 11-12 जनवरी, 1995 को उड़न राख की उपयोगिता पर एक दो दिन की कार्यशाल का आयोजन किया।

क्षे अ प्र को अनेक लब्ध प्रतिष्ठित व्यक्तियों के स्वागत का गौरव भी प्राप्त हुआ। प्रो. एम. एम. शर्मा, निदेशक, यू डी सी टी बम्बई और सदस्य, वै औ अ प सोसाइटी ने वै औ अ प स्थापना दिवस(1995) व्याख्यान दिया। क्षे अ प्र, भोपाल में आयोजि सत्ताइसवें शांति स्वरूप भटनागर मेमोरियल टूर्नामेंट के पुरस्कार वितरण समारोह की अध्यक्षता डॉ. एस. के. जोशी, महानिदेशक वै औ अ प ने की।

प्रयोगशाला में मौजूदा विज्ञान एवं प्रौद्योगिकीय अवसंरचना में विशेष रूप से सुविधाओं को आधुनिक एवं अद्यतन बनाने के दृष्टिकोण से अनेक क्रियात्मक संकलन किए गये। अतिरिक्त स्थान बनाने के लिए प्रयोगशाला की इमारत में बहुत से परिवर्तन किए गये वै औ अ प ने परिसर में आवासीय कालोनी के निर्माण की अनुमति प्रदान कर दी है।

अनुसंधान प्रकाशनों, सेमीनारों और विशेषज्ञों के साथ परस्पर संवाद के द्वारा उच्च व्यावसायिक मानकों को बनाए रखने के लि भरसक प्रयास किए गये। प्रयोगशाला में प्रेरणात्मक माहौल बनाए रखने के लिए प्रबुद्ध वैज्ञानिकों और प्रौद्योगिकीविदों द्वारा व्याख्या तथा अनेक सेमीनार आयोजित किये गये।

विशिष्ट अनुसंधान एवं विकास परियोजनाओं को प्रायोजित करने वाले विभिन्न सरकारी विभागों, संस्थानों और उद्यमों द्वारा दि गये सहयोग के प्रति क्षे अ प्र कृतज्ञ है। उनके साथ निकट परस्पर संवाद से अर्थपूर्ण अनुसंधान एवं विकास सहयोग के नये यु का सूत्रपात हुआ।

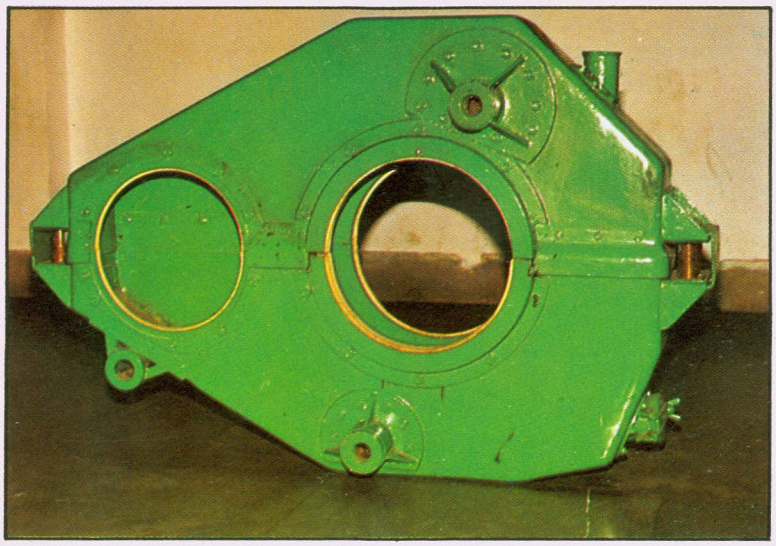
अनुसंधान एवं विकासात्मक प्रयासों में दिए गये दिशा निर्देशों के लिए क्षे अ प्र, भोपाल विशेष रूप से डॉ. पी. रामा राव, सेक्रेट विज्ञान और प्रौद्योगिकी विभाग और चेयरमैन, अनुसंधान परिषद्, डॉ. एस. के. जोशी, महानिदेशक, वै औ अ प, अनुसंधान परि के सदस्यों और प्रबंध परिषद् की आभारी है। वै औ अ प मुख्यालय से मिला नेतृत्व, प्रयोगशाला के लिए अत्यंत महत्वपूर्ण है

क्षे अ प्र, भोपाल के सभी वैज्ञानिक एवं कर्मचारी प्रयोगशाला के विकास एवं प्रगति के लिए पूर्ण निष्ठा से कार्यरत रहे।

टी. सी. रा

(टी. सी. राव)
निदेशक

Executive Summary

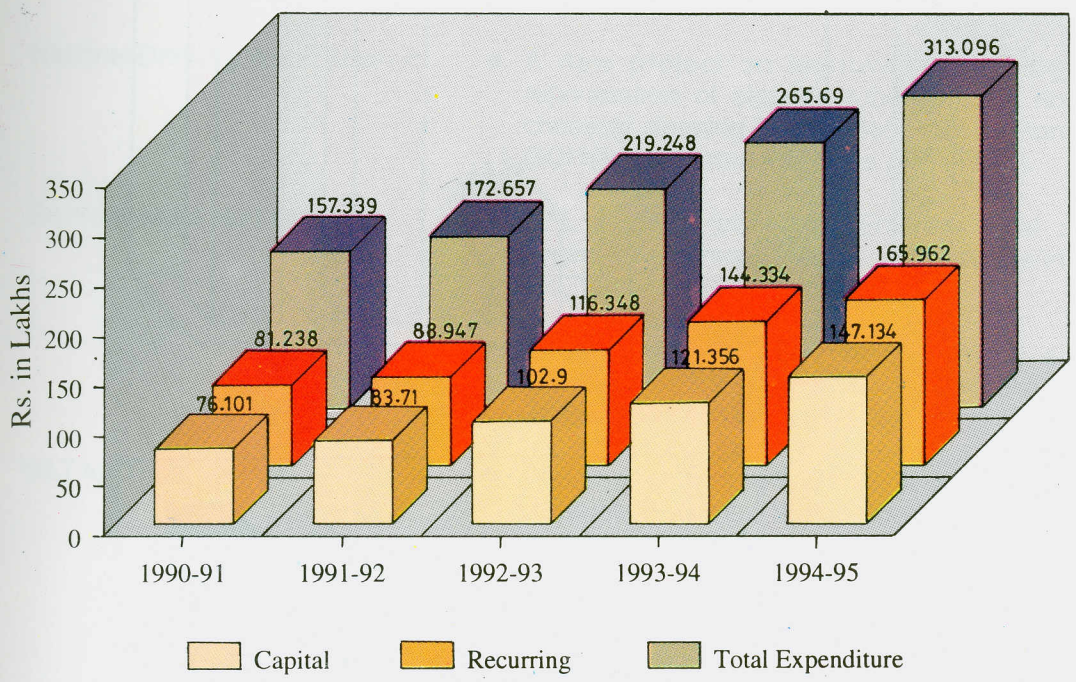


SIGNIFICANT DEVELOPMENTS

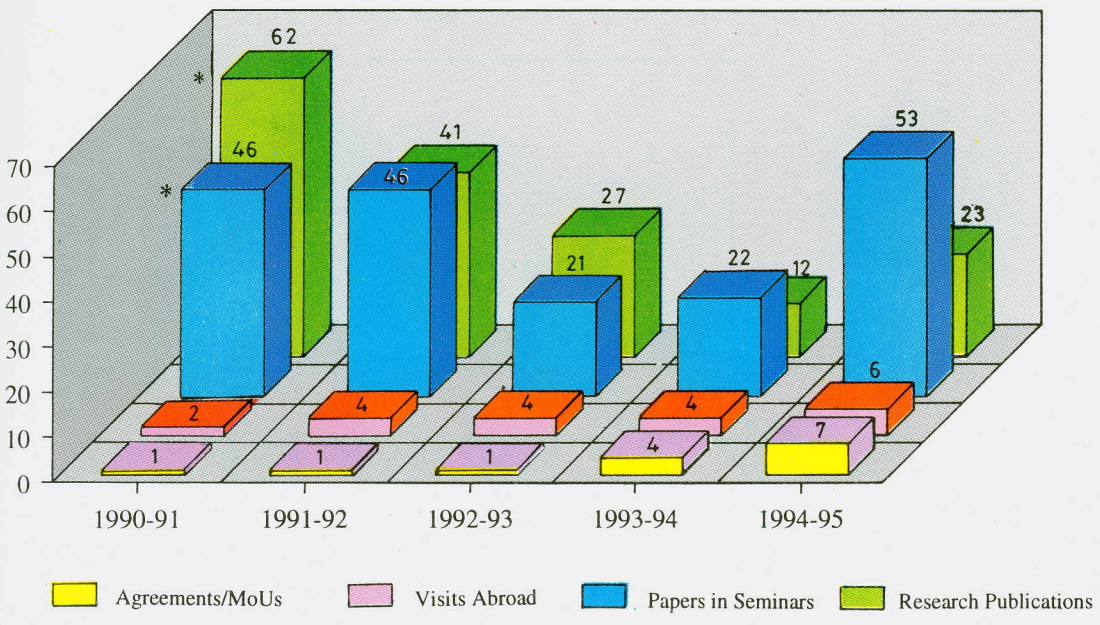
S.No.	Brief description	Present status
1.	FRP Gear Case for Traction Motors	• Six cases were fitted on Loco No. 166604 by Diesel Locomotive Works. "Nothing adverse has been reported by user South Central Railway" as per RDSO, Lucknow. Over 10 months trials are completed. • Technology is given to M/s Permali Wallace Ltd.
2.	Coal and Minerals studies	• 600 mm Vorsyl Separator being fabricated at West Bokaro Washeries of TISCO. • Installation of water-only cyclone at Jamadoba Washery of TISCO approved. Progress on coal beneficiation projects reported satisfactory. • CMPDIL sanctioned a new project on industrial application of Vorsyl Separator based on the success of work done by RRL for TISCO. • Fertiliser Minerals project completed and final report with techno-economic analysis is available.
3.	Wood Substitutes	• Interaction with NTPC, Ramagundam, NALCO is expected to lead to projects on use of fly ash and red mud respectively for wood substitute. • BMTPC is advising on marketing strategies for these products. Production of door shutters for prototype housing being undertaken. • Modifications on processing and design for weight reduction are being planned. • Products based on ipomoea carnea a locally available shrub have been made on lab scale.
4.	Prototype Housing Units	• 16 Apartments are being built (supported by NBO) as demonstration units for CSIR technologies such as clay fly ash bricks, RMP doors, red mud cementitious binder and pre-cast roofing.
5.	Centre for Characterisation of Building Materials	• Centre is equipped with modern facilities worth over Rs.100 Lakh with DST and BMTPC funding. • Centre has carried out specific characterisation and evaluation assignments. • Steps initiated for accreditation so that the Centre becomes a major National facility.

S.No.	Brief description	Present status
6.	MMCs Squeeze casting Preforms etc.	• Agreement with Atlas Automotive Compon Pune & ICICI have been signed. • For preforms process modifications were Crushing strength of more than 1 MPa (A by General Motors, USA) has been a Agreement with M/s Orient Cerwool commercial production of preforms is signe • Brake drum for Maruti Van being fabricat collaborator M/s Rasmi Die Castings
7.	Fly ash utilisation for Wasteland Development	• Pilot project at NTPC, Rihandnagar, on 15 a is completed satisfactorily. Similar projects at NTPC, Ramagundam and NALCO.
8.	Resources Development	• Projects have been structured into three a — Groundwater Resources Managem — Contamination studies — Watershed Development • A National Workshop on Watershed De held on February 24-25, 1995 under au Rajiv Gandhi S&T Mission of Govt. of MP, DST to chalk out action plan of the miss Minister Shri Digvijay Singh inaugur workshop. • Projects supported by DST, MP State UNICEF, NABARD and Rajiv Gandhi M Watershed Dev. are in progress in Hosh Dhar, Khandwa, Seoni, Chhindwara, Guna and Bilaspur districts. The project area water-logged and water-scarce regions.
9.	Mine Implements	• Field trials at Rajrappa Mines taken up assurance tests of the castings were c using radiographic metallurgical, trib techniques. • Hard facing materials suitable for AFC been selected and 3 pans were hard Moonidih for field trials.
10.	Farm Implements	• Field trials related to wear studies of cultivator shovels in black sandy clay loam, clay loam, and black clay (wetland) ha carried out by Tamil Nadu Agri. Un Coimbatore.

EXPENDITURE

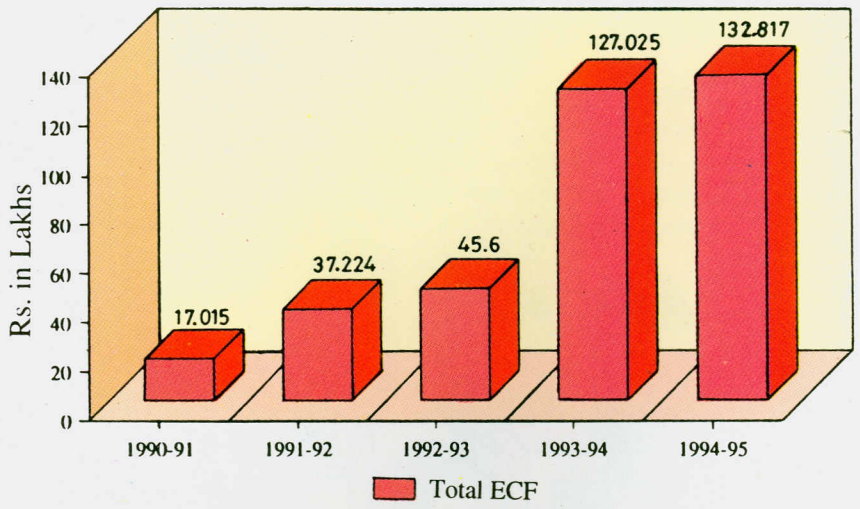


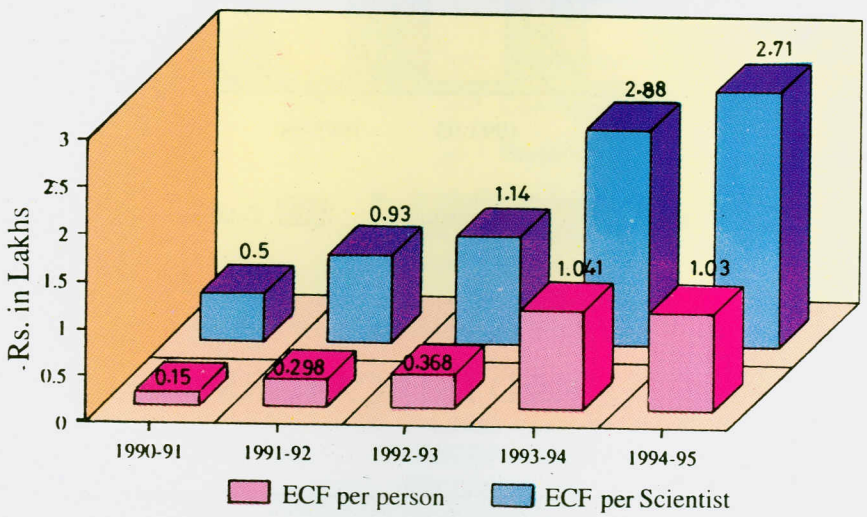
R&D INDICATORS

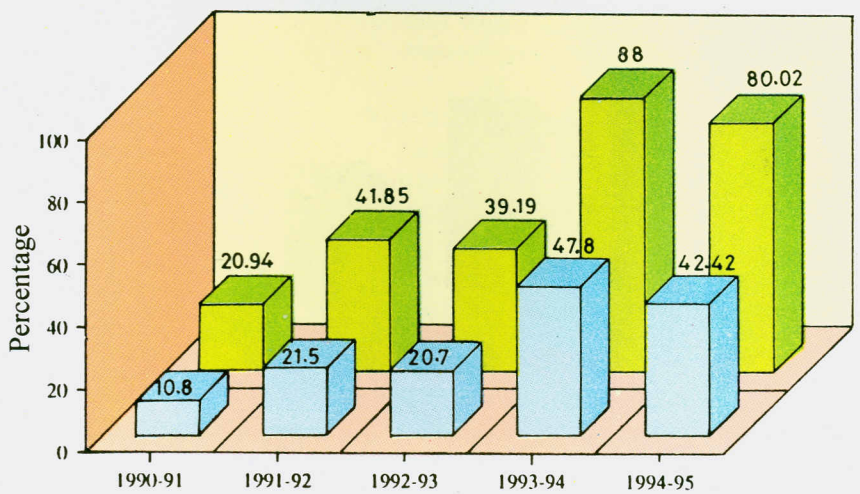


* For the period Jan. 89 to Dec. 90

EXTERNAL CASH FLOW







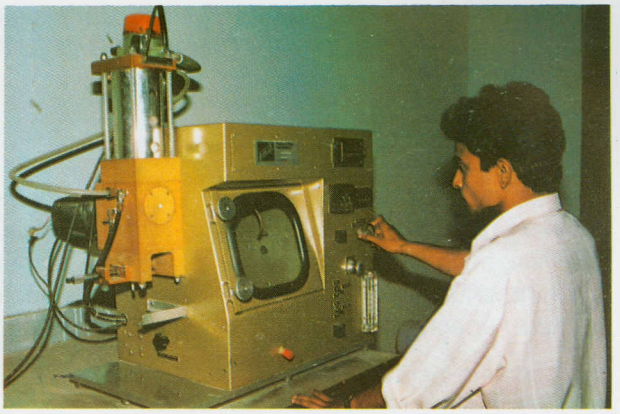
S.No.	Brief description	Present status
		• A get-to-gether of farm machinery manufacturers was held at RRL on 30.12.95 in which more areas of application of improved implements were identified.
11.	National Drinking Water Mission	• A new project on improved technologies for rejuvenation of clogged tube-wells by non toxic chemical cleaning is launched. Min. of Rural Dev., GOI has supported this three year project.
12.	Environmental studies	• RRL plans to undertake Environmental studies, impact assessment, risk assessment, safety audit etc., for industries in the region. • Two joint projects are being carried out with collaboration of NEERI, Nagpur in the area of Groundwater contamination assessment.
13.	S&T for Tribal Women	• Training of trainers amongst tribal women in preparation of herbal formulations, handicrafts based on sisal fibres has been undertaken. Training was also carried out in backward areas of Chhindwara district.

AGREEMENTS FOR COLLABORATIVE WORK/TECH. TRANS

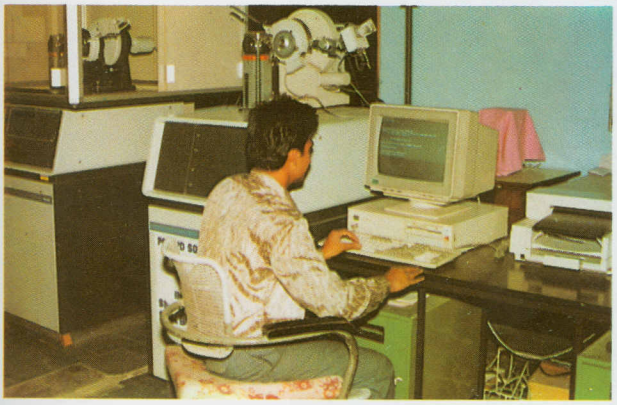
S.No.	Name of Party	Date of agreement	Nature
1.	M/s Rasmi Die Castings Ltd., Secunderabad.	13.10.93	Collaborative arrangements for Component Development on Al-alloy based particulate composites.
2.	M/s Atlas Automotive Components Ltd., Pune.	09.11.93	Collaborative arrangements for development of a process for manufac of Al-alloy casting by squeeze casting incorporating ceramic fibre preforms a salt cores for making AMMC castings.
3.	M/s Rasmi Die Castings Ltd., Secunderabad.	13.01.94	Component development based on Si alloys.
4.	M/s Meena Industries, Govindpura, Bhopal.	23.03.94	License for manufacture of R-Wood d panels, etc.
5.	M/s Encons Ltd., Bhopal.	28.03.94	- do -
6.	M/s Environmental Technologies India Ltd., Nagpur.	25.10.94	Clay fly ash bricks.
7.	M/s Bharat Zinc Ltd., Bhopal.	30.11.94	Lab scale process for reduction of magnesite into leachable manganese oxide.
8.	M/s. Orient Cerwool Ltd., Lakhtar.	03.12.94	Royalty terms for ceramic fibre prefo
9.	M/s Elcaps Ltd., Mandideep.	25.01.95	Technology transfer on Low voltage electrolyte.
10.	M/s Permali Wallace Ltd., Bhopal.	07.02.95	Technology transfer on FRP gear ca
11.	M/s Bharat Zinc Ltd., Bhopal.	24.03.95	Collaborative project on leachable manganese oxide for pyrolusite.

MAJOR FACILITIES

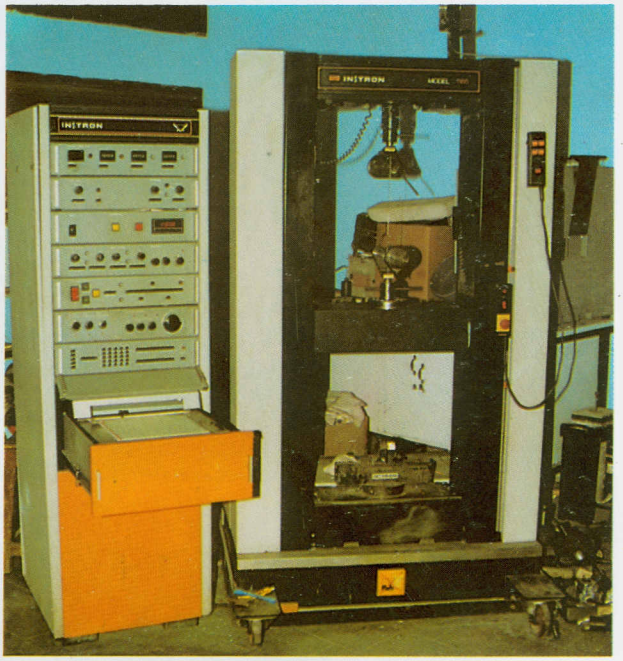
Scanning electron microscope



Gas jet erosion tester



X-ray diffraction unit



Universal testing machine

Chemical analysis laboratory

RRL has modern equipment and instrumentation for chemical analysis, minerals processing, mechanical testing and metallography in addition to well-equipped foundry, workshop and Library. The equipment include: Scanning Electron Microscope, X-ray Diffractometer with PC-APD software, TAS Plus Image Analyzer, Atomic Absorption Spectrometer, DCP Spectraspan, Simultaneous Thermal Analyzer, Particle Size Analyzer, INSTRON Universal Testing Machine, Stress Rupture Testing Machine, Friction and Wear Testing Machine, Rubber Wheel Abrasion Tester, Gas Jet Erosion Tester, Bearing Test Rig, Talysurf Apparatus, Fatigue Testing Machine, Pressure Die-casting Machine, Melt Spinner, 150 T Hydraulic Press, High Temperature Furnace, Plasma Spray Unit, Computerised Hysterisisgraph, Mozely Hydrocyclone, Wet High Intensity Magnetic Separator, Mozely Mineral Sepa-

rator, Mozely Vanner, Mozely Multi-Gravity Separator, Wilfley Table, Water-only Cyclone, Hea
Cyclone, Vorsyl Separator, Flotation Cells and Columns, Air-sparged Hydrocyclone, computer

A centre for characterisation of Building Materials is being set up at RRL Bhopal with suppor
Building Materials Technology Promotion Council (BMTPC) of Min. of Urban Development, D
of Science and Technology and CSIR.

SERVICES OFFERED

Consultancy services and technical services comprising testing and analysis, training, ass
advisory nature, etc. are extended. Major areas are specialised materials testing, engineer
analysis, building materials characterisation, minerals processing, environmental impact as
environmental auditing, safety auditing, hydrogeological investigation, effluent treatment pla
and user specific software development.

Our clientele includes MPEB, NFL, TISCO, BHEL, EPCO, NMDC, UNICEF, OTL, Lupin Labs
industries in the region.

In-situ dye penetration test

Metallurgical investigations on plant components

* * *

Executive Summary

Linkages

Linkages

Central Govt. Agencies and other Institutions

State Govt. Agencies

Industrial Sector

CSIR Institutions

Central Govt. Agencies and other Institutions

Department of Mines, Indian Bureau of Mines, Department of Science and Technology, Depa Atomic Energy, Ministry of Urban Development, Housing and Urban Development Corporati Space Research Organisation, Defence Metallurgical Research Laboratory, Indian Council o tural Research, Central Institute of Agricultural Engineering, Central Groundwater Board, Nati for Agricultural and Rural Development, Indian Institute of Science, Indian School of Mines Materials and Technology Promotion Council, Central Public Works Department, Nationa Organisation, UNICEF.

State Govt. Agencies

Madhya Pradesh Council of Science and Technology, Madhya Pradesh State Mining Co Water Resources Department, Public Health Engineering Department, District Administratio Regions, Rajiv Gandhi S&T Mission Directorates, Environmental Planning and Coordination tion, Tawa Ayacut Development Authority, Madhya Pradesh Electricity Board.

Industrial Sector

Bharat Heavy Electricals Limited, Bhopal; National Aluminium Company, Bhubaneswar; Ce Planning and Design Institute Limited, Ranchi; National Thermal Power Corporation, Rihandr Ramgundam; National Mineral Development Corporation, Hyderabad; Hindustan Zinc Limited TISCO, Jamshedpur; M/s Orient Cerwool Limited, Lakhtar; M/s Permali Wallace Limited, Bh Diamond Cements Ltd., Damoh; M/s Rasmi Die casting Ltd., Hyderabad, M/s Atlas A Components Ltd., Pune, M/s Bharat Zinc Limited., Bhopal, M/s Elcaps Ltd., Bhopal, M Telecommunications Limited, Bhopal, M/s Environmental Technologies (India) Ltd., Nagpur Fertilisers Ltd., Guna.

CSIR Institutions

National Environmental Engineering Research Institute, Nagpur, Indian Institute of Chemical ogy, Hyderabad, Central Leather Research Institute, Madras, Central Building Research Roorkee.

Building Materials

Research areas of this Division are as follows:

- Development of low cost/alternate building materials, components e.g. sisal cement roofing sheets, panels bricks etc.
- Demonstration low cost housing units
- Fly ash, red mud utilization
- Fibre reinforced polymer materials

Research programmes in this Division have evolved from the strong linkages built with Ministry of Urban Development, Building Materials Technology Promotion Council, HUDCO, NBO, NTPC, MPCOST and M.P. State agencies.

Status of the projects in the Division are shown in Table I.

Table I : Projects in Building Materials Division

Sl. No.	Technology/Project	Agency	Project Cost (Rs.in lakh)	STATUS
1.	A study on mechanical properties of sisal fibres produced in M.P.	MPCOST	0.524	ongoing
2.	Development of sisal red mud polymer composites for building components as wood substitute.	BMTPC	8.50	ongoing
3.	Building materials characterisation and testing centre (Phase-I).	BMTPC/DST	72.00	completed
4.	Building materials characterisation and testing centre (Phase-II).	BMTPC/DST	59.10	ongoing
5.	Pilot project for wasteland development.	NTPC	12.00	ongoing
6.	Construction of 16 prototype houses using innovative construction techniques and materials.	NBO	15.00	ongoing
7.	Development of ipomoea polymer composites.	NBO	4.50	ongoing
8.	S&T inputs in the life of tribal women of Patalkot, district Chhindwara.	CSIR	0.70	ongoing
9.	Development of photo-clear flexiglass moulding.	BHEL	3.75	ongoing
	Total value of ongoing projects.		Rs.176.074 lakh	

Wood substitutes

Marketing and commercialisation of wood substitute products based on RRL technologies is being done under the guidance of BMTPC. A folder R-Wood indicating the technical features of the RMP door shutters and comparative costs of alternate shutters was published by the BMTPC. This brochure has been widely distributed during the International Symposium on "Bio composites and blend base on jute and allied fibres" towards disseminating information that would facilitate its commercial production.

Wood substitute products

Table II shows a comparison of red mud polymer (RMP) wood substitute door with other produ RMP is a 100% wood substitute material and it is proposed to use this in the sixteen prototype being constructed under a project funded by NBO.

Table II : Comparative cost of alternate door shutters (Size of doors = 2.00 x 1.00

Door	Red Mud Polymer Door	M.S. Door	Timber (teak)	P.V.C.	Medi Densit
Cross section	Door frame 105mm x 60mm flush/panel door shutter 30mm	Door frame 105mm x 60mm shutter-frame 30mm x 30mm, panel particle board with laminates	Door frame 100mm x 75mm, shutter-frame style and top rail 100mm x 35mm, lock rail 150mm x 35mm	Panel timber 18 mm	Door fra 40mm x shutter-f 60mm x panel 20
Initial of cost shutter including Chowkhat	Rs.2305.00	Rs.2637.00	Rs.4000.00	Rs.4800.00	Rs.1968
Cost per year life of product (including maintenance cost and cost of capital @ 18%)	Rs. 311.00	Rs. 620.00	Rs. 776.00	Rs. 910.00	Rs. 341

Pilot project on Wasteland Development at NTPC, Rihandnagar, U.P.

Rihandnagar Super Thermal Power Project (Rh.STPP) is one of the central sector undertaking power plant located at south eastern tip of Uttar Pradesh. This power plant generates 1000 MW power from two units of 500 MW each. While generating power the plant releases huge quantity of ash during the combustion of coal. This is a potential source that can lead to ecological and environmental degradation. Also large area of valuable land is occupied for dumping the fly ash.

During the year 1994-95 project activities were carried out a Nilgiri site and Dodhar site, covering an area of 15 acres. Thirty five thousand tonnes of fly ash was used for filling for land reclamation, and 265 ton/acre of ash was mixed for soil amendment.

The fly ash filled area was covered by spreading soil to a thickness ranging between 30-50 cm and further conditioning. Improvement in plant growth, better crop yields of cereals, vegetable crops etc. have been observed.

Shri Rajinder Singh, Chairman NTPC, visiting the test site at Rihandnagar

The observations of the first three cropping rotations show that

- the yield increased from 16-58% more in ash mixed sites, and
- saving irrigation water is 20-30% with the application of ash mixing.

Products grown in ash mixed site have been tested at Industrial Toxicological Research Centre, Lucknow and Central Food Technological Research Institute, Mysore. The toxic element/heavy metal uptake by vegetables and fruits have been found to be well within the tolerance limits.

The micro and macro nutrients, present in soil sample were analysed by Direct Current Plasma Spectrophotometer (DCP), Iron Selective Electrodes, Atomic Absorption Spectrophotometer. The *p*H value was determined colorimetrically and the mineral phases of samples was determined by X-ray Diffractometer.

Building materials characterization and testing centre

The Centre is being equipped with modern facilities, and is being set up with financial assistance (o Rs. 130 lakhs) from BMTPC, DST and CSIR. The Centre has started attracting a variety of char terisation and evaluation assignments from industry and other agencies.

This Centre at RRL, Bhopal has been established to expand base for characterization and certificat of existing/new alternate building materials to cater the needs of various construction agencies e CPWD, Railway, MES, Housing Boards, State PWDs and other construction and manufactur industries. In view of the liberalisation of economy and incentives towards utilization of industrial was by Central Government many new products are coming in the market which require performan evaluation and subsequently certification.

With a view to provide above services advanced facilities and testing equipment have been acquire

- Universal Testing Machine (200 T capacity)
- Non Destructive Testing Equipment
- Flexural Testing Machine (100 KN capacity)
- Plate Bearing Test Apparatus

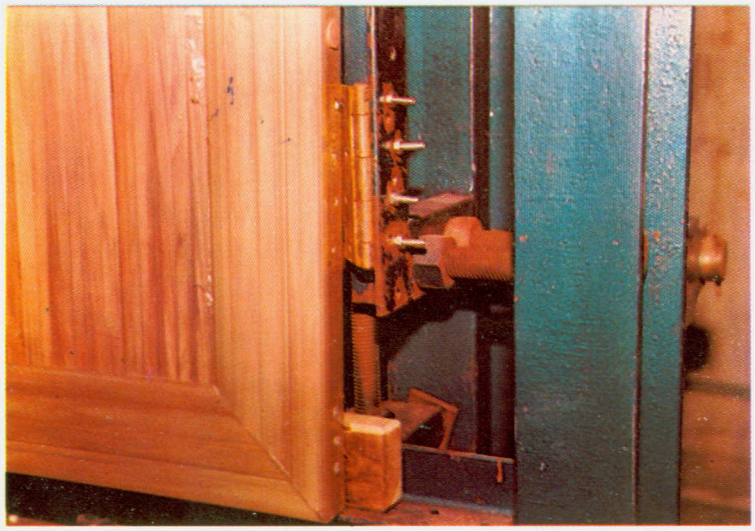
Clay fly ash bricks (inset)

Sixteen apartments being built with NBO, assistance using CSIR technologies

- Door Shutter Testing facility
- Weatherometer
- Pile Integrity tester
- Salt fog and humidity cabinet

In addition auxiliary equipment are also available. The Centre can undertake characterisation and evaluation of a range of materials as mentioned below:

- Cement
- Concrete
- Aggregate
- Metals
- Plastics
- Stone
- Bricks
- Tiles
- Timber/substitute products
- Doors
- Soils
- Foundations
- Paints and protective coatings



Misuse test performed on a door

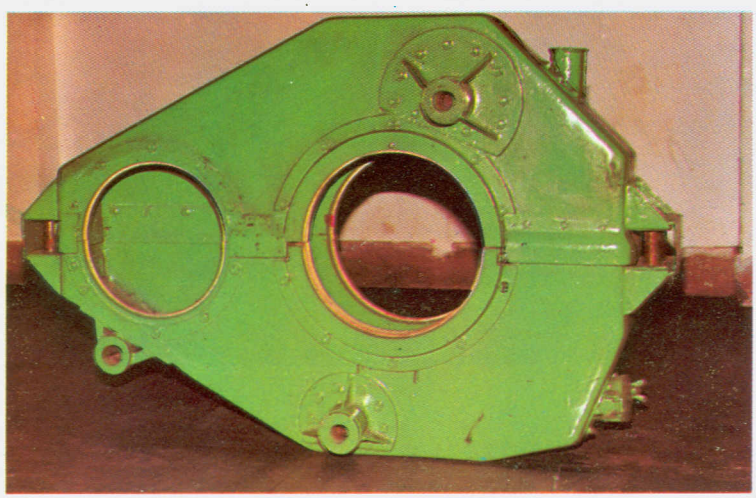
It is proposed to seek accreditation to the Centre from DST. This will help fulfill the need for a major national facility.

FRP gear case for traction motors

An indigenous fibre reinforced plastic (FRP) gear case has been jointly developed by RRL, Bhopal, Permali Wallace Limited, Bhopal and BHEL, Bhopal. This gear case is proposed for traction motor (TM 4906 AZ) of Broad Gauge Diesel Locomotives for use in Indian Railways.

The FRP gear cases have undergone over ten months of field evaluation by RDSO in the South Central Railway. Nothing adverse has been reported. RRL has transferred the technology to M/s Permali Wallace Ltd.

Fabricated from low carbon steel St-42S by welding and bending of sheets of 6-8 mm thickness, the conventional gear cases require lifting facilities for mounting and demounting for greasing and for other maintenance work. FRP gear case weighs 78 kg compared to the steel case which weighs 130 kg. Six cases are used in a locomotive.

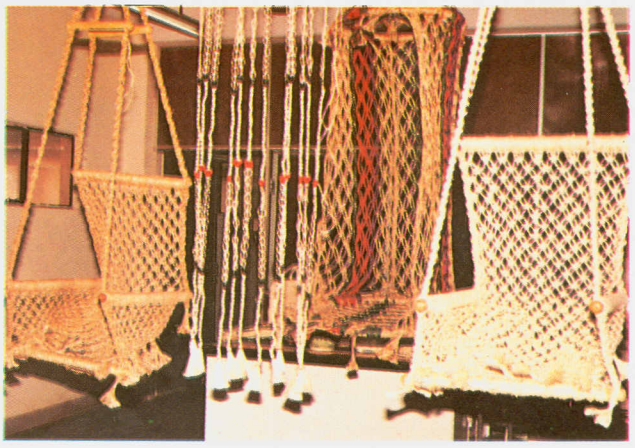


Fibre reinforced plastic gear case

Handicrafts made from Sisal fibres

Handicrafts made from Sisal fibres

Low carbon steel is also susceptible to corrosion and failures in the weld joints leading to the leakage of lubricant. The heavy weight of the steel gear case sometimes causes its detachment from the traction motor due to violent jerks and/or impact which is very common for locomotives. The light weight and corrosion free FRP gear case is expected to offer several advantages over the conventional steel gear case.



Handicrafts made from Sisal fibres

S&T input in the development of tribal women of M.P.

RRL, Bhopal is carrying out work in this area with a view to improving the socio-economic condition of tribal women in and around Bhopal. A number of activities like Herbal products of medicinal value from locally and abundantly available raw materials, rope making, handicrafts etc. have been identified. Training has been imparted to select group of women chosen from economically backward groups from M.P.

This will help in employment generation and fruitful utilisation of locally available raw materials. The aim of the programme is to improve the socio-economic status of tribal women through employment generation by making products of daily use through scientific methods.

The State of Madhya Pradesh is very rich in sisal plants from which fibres can be extracted to make attractive handicraft materials, household and decorative items for daily use. Presently such items are made from jute which has a very high market potential, although its cost is appreciably high. Training is being imparted to local women in this technology. The project has the dual objective of replacing costly jute with locally available sisal fibres and employment generation for economically backward women in M.P.

* * *

Metallurgy & Materials

R&D activities of this Division include the following

- Aluminum based metal matrix composites, ceramic fibre preforms, squeeze casting and squeeze infiltration
- Materials characterization
- Wear related problems in mining and agricultural implements
- Engineering failure analysis
- Welding techniques
- Corrosion

During 1994-95, commensurate with the activities, the division has had impressive linkages with prestigious organizations. These include BHEL, HZL, BALCO, CMPDIL, ISRO, VRDE, DMRL, CBIP, MPEB, ICAR, CIAE and a large number of industries in and around M.P.

Status of the projects in the Division are shown in Table II.

Squeeze cast components

Trials on Squeeze Infiltration of Al-alloy into the preforms of SiCw and of Alumino Silicate short fibre with varying range of volume fractions were successfully conducted. It is now possible to achieve 60 mm squeeze infiltrated length using optimised key process parameters.

Country wide survey was made to identify the organisations having facilities of rolling and extrusion. BARC, Bombay has extended their help to utilise their facilities and expertise in these fields. Rolling of a few ingots made by squeeze infiltration technique has been conducted. They are, however, interested in getting ingots of rectangular shape for this purpose. The placement of order for fabricating die suitable for obtaining rectangular ingots is in progress. BARC has also agreed to extend their facilities of extrusion. Ingots have been supplied to them.

Mechanical properties have been improved by 20% over gravity cast metal matrix alloys. Results have been communicated to VSSC, Trivandrum.

A project on development of automobile components by squeeze casting and the squeeze infiltration technique has attracted financial support by ICICI under its World Bank assisted SPREAD programme.

AACL, Pune has completed all the formalities with ICICI. Components have been selected for this developmental work. Planning for starting the work with AACL, Pune has been initiated.

Development of Alumino-silicate short fibre preforms in semi-commercial scale

A number of trials of milling and washing were conducted using mineral beneficiation techniques in order to obtain highly dispersed fibre with shot content of less than 0.01%. Milling trials were conducted using rod mill and ball mill in dry as well as in wet condition. It is examined that step melting in wet condition using rod mill gives better control over fibre length which is the most important factor for controlling preform volume fraction.

Washing trials were conducted using technique. The fresh water rate, feed rate, slurry composition, stroke length, speed and slope of table has been optimised in order to obtain shot content less than 0.01%.

Preform crushing strengths were determined, following ASTM standard method, using 1 Ton "Instron Testing Machine". It was observed that these preforms satisfy the strength (i.e. 1 MPa) as desired by General Motors, USA.

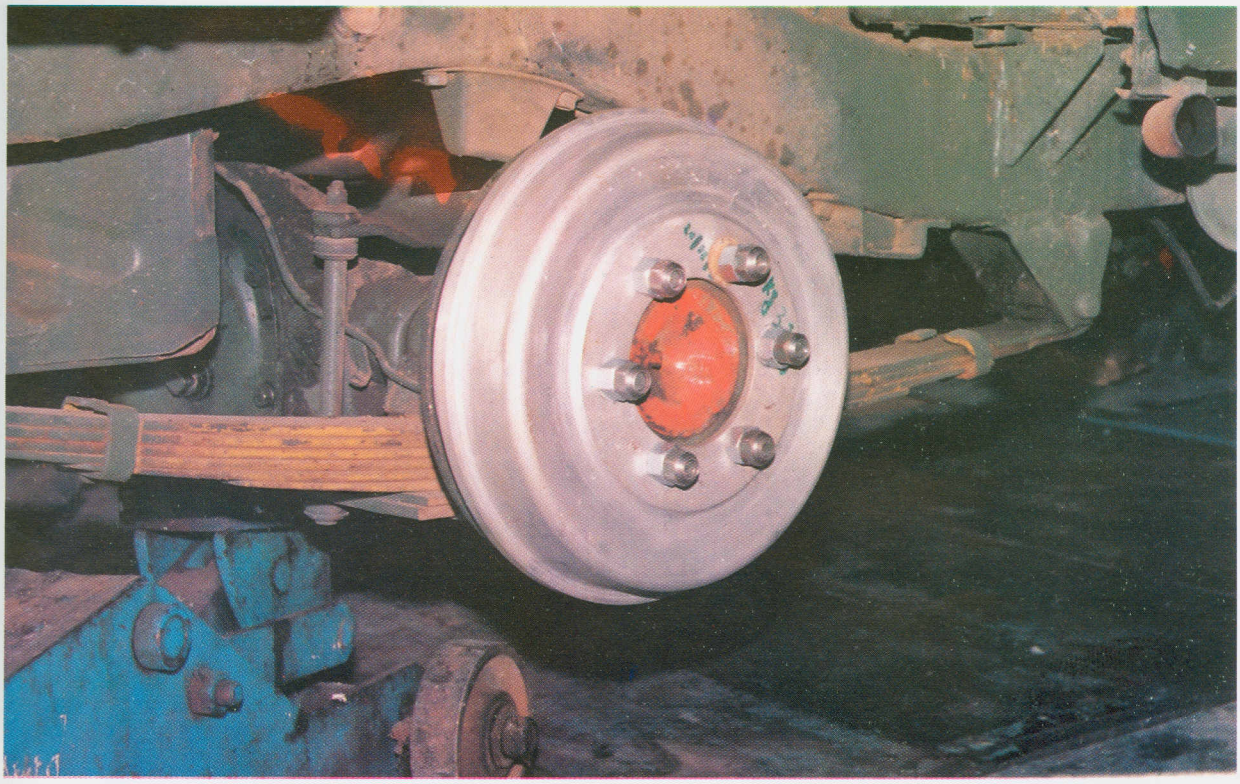
Table III : Projects in Metallurgy and Materials Division

Sl.No.	Technology/Project	Agency	Project cost (Rs.in lakh)	Status
1.	Process development on a semi-commercial level for ceramic preforms.	OCL	0.50	completed
2.	Improving life of mine implements through tribological studies.	CMPDIL	36.79	ongoing
3.	Development of aluminium metal matrix composites for aerospace applications.	ISRO	10.48	ongoing
4.	Metallurgy and process development for quality upgradation for better performance of critical parts of agr. machinery.	ICAR	9.19	ongoing
5.	Studies on corrosion of modified cast irons.	MPCOST	0.696	ongoing
6.	Development of suitable grinding media for cement.	MPCOST	0.60	ongoing
7.	Structure and properties of advanced high temperature aluminium base alloy through rapid solidification processing.	DST	0.88	completed
8.	Process development for manufacture of bonded magnets of rapidly solidified Nd-Fe-B alloys.	MPCOST	0.20	ongoing
9.	Characterisation of fly ash from ten thermal power station.	CBIP	11.40	ongoing
10.	Fundamental studies on the stress corrosion of metals.	DAE	4.032	ongoing
11.	Surface engineering centre.	DST	2.05	ongoing
12.	Life extension of coal feed bunkers at STPS, Sarni.	MPEB	4.96	ongoing
13.	Failure investigation of coal feed bunker at STPS, Sarni.	MPEB	3.60	ongoing
14.	Survey of medical X-ray equipment.	CSIR	8.00	ongoing
15.	Development of leachable MnO from Pyrolusite.	BZL	1.00	started
16.	Improvement in technique of rejuvenating clogged tubewells.	MRD	9.59	started
	Total value of ongoing projects		: Rs.103.968 lakh	

RESCA brake drum

Al-alloy hard particle composites were prepared at RRL for making brake drum for Maruti Va components for mineral dressing equipment. Metallic moulds for Maruti Van has been made l collaborator M/s Rasmi Die Castings Ltd., Secunderabad. The brake drum for Maruti Van will b at M/s Rasmi Die Castings Ltd. Hyderabad, M/s Bajaj Auto Ltd., Pune have shown inter development of cylinder block using MMC.

The RESCA brake drum has been tested in a Nissan Jonga Jeep at VRDE, Ahmednagar for a of 2500 hrs.



RESCA brake drum fitted on Nissan Jonga jeep

Surface Engineering Activity - Satellite Centre

Technology Information, Forecasting and Assessment Council (TIFAC), New Delhi, has sponsored a project with an objective to carry out an exhaustive survey of the information, related to various aspects of surface engineering, R&D activities carried out in this direction and typical case studies pertaining to the surface modification of various categories of engineering components. This has been done to enable the dissemination of information to the users/manufacturers of the implements as well as the ones involved in surface engineering activities.

RRL has been entrusted to carry out an exhaustive literature search and market assessment of various surface modification techniques and their application potential together with its current status in Indian industries with regard to improving the wear resistance of farm and mine implements.

Typical case studies pertaining to the mining and agricultural implements, both from literature and through contacts with user/ manufacturing industries in the country, have been dealt with to emphasise the need and potential of subjecting the implements to different surface engineering techniques.

RRL organised one of the workshops at Jamshedpur on behalf of TIFAC. Typical case studies showing the importance, applications and scope of using surface modification processes for improving the performance of farm and mine implements were discussed in the workshop.

Mining implements

Under the project on improving the life of mine implements, sponsored by the Ministry of Coal through CMPDIL, two implements namely shovel teeth and deck plate of AFC pan were investigated.

After laboratory scale investigation on presently used implements and various alternate grades of steel, a few compositions were selected for the manufacture of shovel teeth. Prototype shovel teeth of these

A view of Rajrappa coalmines

compositions have been made at M/s Trishul Castings, Bhopal. Field trials of the newly developed implement is in progress at mining sites at Rajrappa in Bihar and SECL in Bilaspur.

A few available grades of steel having the potential for use as the pan material were studied at the laboratory. It was found that the same can be used as pan after subjecting them to proper heat treatment. Further, a number of appropriate hard facing electrodes suitable for deck plates were evaluated for their wear resistance at the laboratory. On the basis of the results obtained, one composition was selected and hard facing of the pans were carried out at site. Field trials are in progress.

Excavator bucket fitted with shovel teeth supplied by RR

Upgradation of agriculture implements

Tillage, harvesting and weeding agricultural tools are generally fabricated out of mild and mediu carbon spring steel scrap. The material quality and therefore, life of the implements is poor.

Primary tillage implements such as duck foot cultivator, shovel reversible and mould board plough we processed and fabricated at RRL.

A set of shovel teeth

Sweeps made by RRL under field tests

- In case of duck foot cultivator, reduced scouring and about 40% less material loss due to abrasion was noted. Field trials on shovel reversible and mould board plough field test trials were being carried out at Tamil Nadu Agricultural University, Coimbatore. Test soils included black sandy clay loam, red sandy clay loam, black clay (wetland) types.

Development of leachable manganese oxide from pyrolusite ore

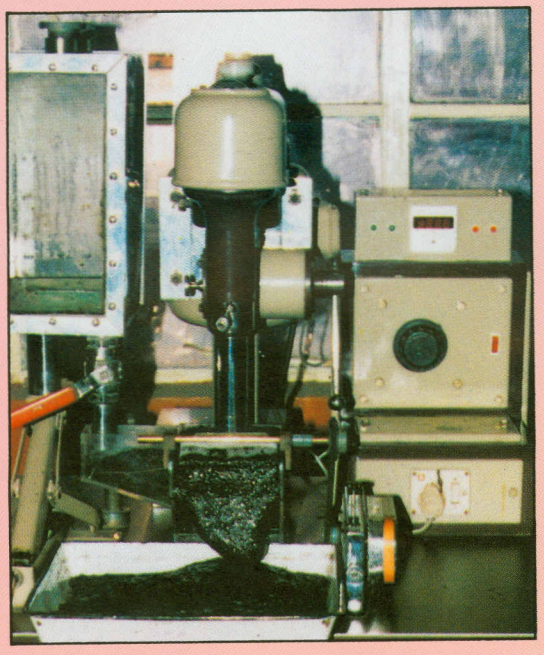
In the secondary zinc recovery process by electrochemical deposition, dissolved Mn (II) is used additive iron in the cell. M/s Bharat Zinc Ltd (BZL) Bhopal approached RRL for development of a proc for this purpose. The laboratory scale process with above 90% conversion of the available mangan in the ore was developed by the laboratory. Based on these results, M/s BZL has requested the upsca of the process to pilot plant scale. This part of work is in progress. The project has been sponsored M/s BZL.

Bell metal craft in tribal regions of M.P.

Dokra craft is a traditional bell metal handicraft from Bastar region of M.P. RRL carried out training demonstration programmes for local artisans and gave suggestions for improvement in the process technique leading to overall quality enhancement.

* * *

Minerals



Main R&D activities of this Division are built around the following

- Beneficiation of low grade ores
- Utilization of some fertilizer minerals of M.P.
- Studies on utilization of alumino-silicate minerals for developing mullite and other value added ceramic materials,
- Beneficiation techniques and modelling studies related to coal and mineral preparation processes.

Major linkages of this Division are with Dept. of Mines, IBM, GSI, MPCOST, M.P. State Mining Corporation, TISCO, HZL, and CMPDIL.

Table IV shows the status of the projects.

Table IV : Projects in Minerals Division

Sl. No.	Technology/ Project	Agency	Project cost (Rs.in lakh)	Status
1.	Beneficiation and industrial utilisation of some fertilizer minerals of M.P.	Dept.of Mines	25.00	completed
2.	Modelling & performance studies on Vorsyl Separator.	TISCO	10.00	completed
3.	Exploratory investigation on utilisation of fly ash for industrial ceramics.	DST	7.324	ongoing
4.	Modelling & scale up studies in water only cyclone treating coal.	CMPDIL	3.00	ongoing
5.	Studies on limestones.	Diamond Cement	0.60	ongoing
6.	Industrial application of Vorsyl Separator in BCCL Coal Washery.	CMPDIL	2.60	started
7.	Installation of Water-only cyclone at Jamadoba Washery.	TISCO	1.00	started
8.	Installation of 24 inch Vorsyl Separator at West Bokaro Washery-II.	TISCO	1.50	started
9.	Performance evaluation of Air-sparged Hydrocyclone to treat Indian Coal Fines.	CMPDIL	9.92	started
10.	Studies on separation characterisation of Dyna-whirlpool treating coal.	DST	7.61	started
	Total value of ongoing projects.		: Rs.68.554 lakh	

Fertiliser Minerals

India with its vast agricultural base remains one of the major fertilizer consuming countries in th The domestic requirements of primary nutrients such as nitrogen, phosphorus and potash (N P being mostly met by imports.

The State of Madhya Pradesh (M.P.) has an estimated reserves of 39.3 million tonnes of lo rock phosphate (% P_2O_5) and 266 million tonnes of glauconitic sandstone (4.67% K_2O) wh potential resources for phosphorus and potash respectively. These vast reserves are not explo far by the fertilizer industries for want of an economically viable processes for its beneficiation.

Realising the importance of effective utilisation of natural resources, a project titled "Beneficiat industrial utilisation of some fertiliser minerals of M.P." was approved by Department of Mines, G India in 1990. This project work has been carried out by RRL, in association with Indian Bureau of The major findings of the detailed investigations carried out during these studies are summarised

a) Rock Phosphate

Extensive studies were carried out on three different types of low grade phosphate ores to de appropriate beneficiation process at lab scale. The results obtained are summarised below:

Type of ore	Feed grade P_2O_5	Concentrate grade (%P_2O_5)	Recovery of (%P (%)
Siliceous	11.5	34.0	70.0
Cherty	12.5	29.3	60.0
Calcareous Dolomitic	5.5	26.3	46.5

As the concentrate obtained from laboratory scale beneficiation studies on siliceous rock phos was found most suitable for the production of Single Super Phosphate, pilot plant studies were ca out on this ore at IBM laboratories, Ajmer. The pilot plant results have validated the laboratory find

Further, pre-feasibility studies carried out on the process developed for the beneficiation of low g siliceous rock phosphate by Indian Institute of Chemical Technology, Hyderabad have revealed the process bears good potential for economical viability.

b) Glauconitic Sandstone

The work was carried out on utilisation of glauconitic sandstone by taking three broad approaches the results are given below:

i) Approach-I : Extraction of potash values in soluble form

Different processes tried on the lab scale and the results obtained are given below:

	Process adopted	% Potassium extracted
a)	Acid leaching	
	Phosphoric acid system	72
	Step extraction	95
	Extraction with low grade rock phosphate	90
b)	Roasting cum leaching	
	With $CaCl_2$	96
	With NaCl	80
	With $CaCl_2$, NaCl	92

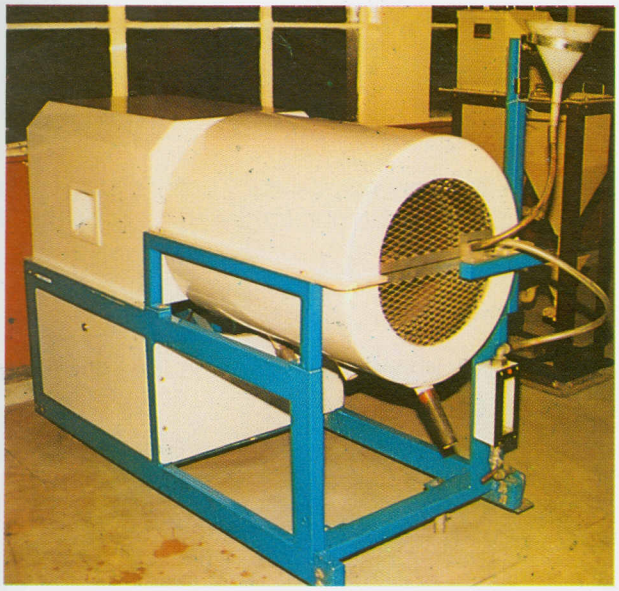
ii) Approach-II : Total utilisation

Studies conducted on total utilisation of glauconitic sandstone revealed reasonably high potential for isolating potash and simultaneously obtaining a suitable clinker for cementitious materials. The clinker obtained is found to have cementitious phases and related properties.

iii) Approach-III : Physical beneficiation and utilisation

A process consisting grinding, hydrocyclone and magnetic separation has produced concentrate having 6% K_2O and 63% recovery.

Two different types of fertilizers, one in solution form by leaching and the other in solid form by acidulation have been produced from the glauconitic concentrate using sulphuric acid as medium and fluorite mineral as additive.



Multigravity separator for heavy minerals

SiAlON whiskers grown from selected flyash particles

Though the above results have shown the technical feasibility of extracting potash from glauconitic sandstone, the economic viability has to be looked into before carrying out pilot plant/feasibility studies.

Low ash coking coal by Vorsyl Separator

At West Bokaro site of TISCO, a 400mm Vorsyl Separator was installed on the recommendation by RRL. During 1994-95 the laboratory has got a constant feed back on the performance of the unit. It has been reported that this development signifies extra 50 tpd. of clean coal (17.3% ash) without any additional costs. Coal India Ltd. has shown keen interest in this development and has sponsored project with RRL. Installation of industrial scale Vorsyl Separators at other Coal Washeries in the country will generate necessary confidence to facilitate adoption of this technique.

Scale-up studies on water-only cyclone

The project was initiated jointly by RRL and Indian School of Mines, Dhanbad. The main objectives of the work are:

i) Carrying out experiments in the laboratory using water-only cyclones of different diameters, on coals from Jharia and Madhya Pradesh,

ii) Performing experiments (to the possible extent) at the plant scale level to analyse se efficiency of water-only cyclones.

iii) Critical analysis of effect of design and operating variables on the performance of wa cyclones (of both laboratory and industrial size).

The results obtained from the tests on 76 mm water-only cyclone including effects of design and p variables on the performance of water-only cyclone are discussed below.

Effect of vortex finder length : It has been noted from the results that increase in vortex finde decreases the yield. For example, increase in vortex finder diameter from 119 mm to 124 mm dec the yield from 84.54 to 73.39. Increase in vortex finder length might decrease the probability of p reporting to overflow and hence reduces the yield.

Effect of vortex finder diameter : The results obtained from the experiments on water-only cyclon shown that an increase in vortex finder diameter increases the yield and ash content of the conce

Effect of feed solid content : The results show that the increase in feed solids content increase yield and ash content of clean coal. This increasing nature may be due to increase in the autoge medium density inside the cyclone with increasing feed solids content.

From the results obtained, it is evident that the Monodih coal fines can be efficiently beneficiate a water-only cyclone where the yield of clean coal upto 71.58% can be obtained with ash con 17.37%.

Installation of water-only cyclone at Jamadoba washery

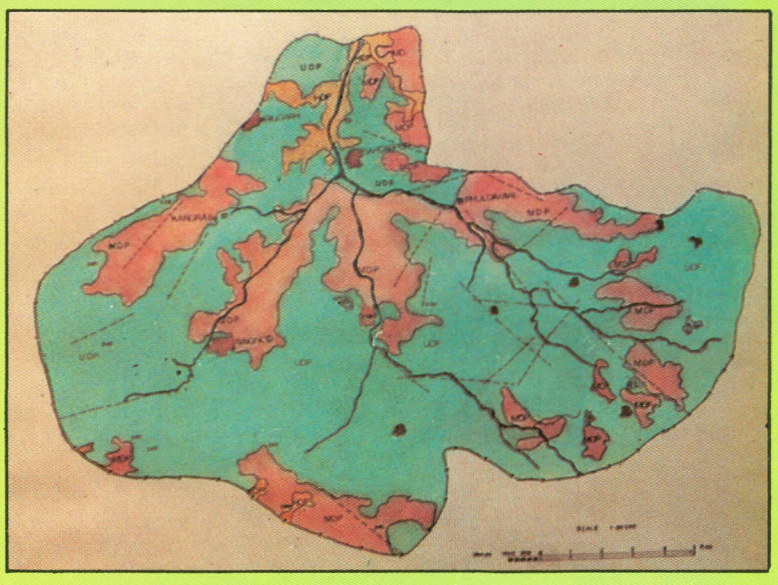
The objective is to establish the efficacy of water-only cyclone for beneficiation of Jamadoba coa (0.5 mm) as an alternative to froth flotation.

Presently froth flotation is being practiced to treat the coal fines at Jamadoba washery. Though flo is an efficient process, it becomes very costlier when compared to simple gravity concentration pro Water-only cyclone is an effective technique for treating coal fines and hence it has been sugg for the studies.

If the water-only cyclone is found suitable and the existing flotation process is replaced there w significant savings from power consumption, lower maintenance cost, higher capacity per unit reagents cost etc.

* * *

Resources Development



Resources Development Division of RRL, Bhopal has active R&D programmes in water resources management. Set up recently (1990) the Division has mandate to carry out computer aided studies in integrated water resources management supported by field studies and surveys. Main capabilities of the laboratory exist in mathematical modelling and systems analysis. The division has three major activities in the area of Ground Water Resources Management and Ground Water Contamination. The activities broadly fall under following:

- Groundwater Resources Management
- Groundwater Contamination Studies
- Watershed Development

At present seven sponsored projects are on going in the above three subjects and two projects are on the verge of completion. A list of on-going projects is presented in Table V. A brief description of each project category wise is presented in the following pages.

Table V : Projects in Resources Development Division

Sl.No.	Technology/Project	Agency	Project cost (Rs.in lakh)	Status
1.	Groundwater evaluation through modelling in the area of Tawa river basin.	DST	8.97	completed
2.	Micro-level study on water-logging problem at Kharar village Seoni-Malwa block, Hoshangabad district, M.P.	TADA	5.45	ongoing
3.	Groundwater balance studies in dark areas with special reference to Sanwar block, Indore dist.	NABARD	5.21	ongoing
4.	Artificial recharge studies in two blocks of Dhar dist. of M.P.	UNICEF	4.00	ongoing
5.	EIA for RPL, Jamnagar - Water quality studies.	NEERI	2.50	ongoing
6.	EIA for TNPCB, Madras - Water quality studies.	NEERI	1.50	ongoing
7.	Wastewater characterization for OTL, Mandideep.	OTL	0.40	ongoing
8.	Preparation of base maps and watershed maps for 13 EAS/DPAP districts of M.P.	RGMWD	5.00	completed
9.	Preparation of thematic maps for selected watershed in six districts of M.P.	RGMWD	45.00	ongoing
10.	Miniaturisation of separation systems.	EEC	90.00	ongoing
	Total value of ongoing projects		Rs.168.03 lakh	

Groundwater Resources Management

Focus has been placed on two major problems namely water-logging and water-scarcity. RRL has b working on the water-logging problem in Tawa Canal Command Area, Hoshangabad district regional level for the past four years. Since last one year a pilot scale work is progressing a sele area (Kharar) located within the Tawa Canal Command area for suggesting remedial solutions to co the water-logging. On the water scarcity front RRL is concentrating in the western Madhya Pra where drinking water is problem in summer months. In the first instance emphasis is placed on district and detailed work is progressing in Sardarpur and Badawanar blocks. On the basic rese front a field linked project to asses the groundwater potential in a problematic area, Sanawer blo Indore district is progressing.

Watershed Development

RRL, Bhopal at present involved in two major activities for Rajiv Gandhi Mission for Water Development (RGMWD), Government of Madhya Pradesh, namely Preparation of Base Maps Watershed Maps in 13 EAS/DPAP districts of M.P. and Preparation of Thematic Maps for 6 sele districts of M.P. Out of these two activities first activity is completed and watershed maps Hoshangabad, Mandla, Balagrah, Raipur, Raigarh, Sehore, Raisen, Durg, Shajapur, Rewa, Da Panna and Jabalpur districts. The second activity of preparation of thematic maps for six districts na Khandwa, Bilaspur, Chhindwara, Guna, Seoni and Rajgargh is progressing. RRL has organis workshop on "Watershed Development" during Feb. 24 and 25, 1995 by involving various reso personnel across the country.

Chief Minister Shri Digvijay Singh (seated on left) inaugurated the National Workshop on Watershed Development

Groundwater resources management through mathematical modelling in the Tawa left bank canal command area, Hoshangabad dist. M.P.

Linear programming based lumped Management model is prepared. The model is being calibrated for the aquifer parameters. Computer code for the management model is being developed. Aquifer performance tests for understanding aquifer properties have been conducted in selected locations of the study area. Final report is under preparation.

Micro level studies launched on water-logged areas in Kharar village

Study on micro level water-logging remedial solutions around Kharar village, Hoshangabad dist. M.P.

The project is supported by Tawa Ayacut Development Authority and envisages involvement of local people and administration. Field surveys to demarcate the water logged areas did not indicate any water logged area within distance of half km to one km towards north of the main canal. Hence the construction of parallel channels along the canal was not found necessary. The field studies showed that the areas between Dawadiya distributory and Lohariya distributory indicated water logged areas.

Inspection of sites by RRL for piezometer installations at Kharar villege

Groundwater balance studies in dark areas with special reference to Sanwer block, Indore dist. M.P.

The project is supported by NABARD with a objective to make a quantitative evaluation water resources and their distribution in dark areas. The work involves comparison of the individual sources of water in the system over different periods of the year and studying their effect on variations in the water regime.

Base maps were prepared using Survey of India toposheet No.46 N/13 on 1:50,000 scale. It is observed that the study area lies between latitudes 22° 48′ and 22° 59′ North and longitudes 75°45′ and 75°52′ East. The study area covers about 100 Sq km area. Drainage net work map of the study area has been prepared.

In the first phase, a detailed field survey was conducted in 20 villages of Sanwer block falling in study area, have been considered as observation points out of total 70 dug wells present the st area. The area is mostly occupied by basaltic lava flows locally known as Malwa traps. It is almost terrain with general slope towards north and is drained by Katkiya nala along with its tributaries. In southern part of the area has flat topped hill ranges tending to north-south direction, these hill ran run almost parallel to Indore-Ujjain road.

A total 75 number dug wells have been identified during 100% inventory operations in 20 village should be noted that all the wells in these villages are dry and not yield any water. The only source water for cultivation and drinking are the tube wells and many of them are on the verge of drying up some places dug-cum-bore wells are present with total depth of about 100 m and yield very little quan of water. The tube wells taping shallow groundwater aquifer occur in the vesicular, jointed and fractu basaltic zones.

Artificial recharge studies in Sardarpur and Badnawar blocks of Dhar district, M.P.

The project is sponsored by UNICEF to carry out geomorphological investigations, monitoring of grou water levels and designing of site specific water conservation structures.

In the first phase, a detailed field survey was conducted in 24 villages of Sardarpur and Badnaw blocks, to understand the local geology and to identify topographical features. Base maps were prepa using Survey of India toposheets on 1:50,000 scale for both blocks indicating observation stations a drainage net work of the study area. Water table contours were also plotted on the basis of collec water table levels in the field. Based on the satellite data thematic maps for land use/land cover a hydrogeomorphology have been prepared for both the blocks.

A dry well in a village in Dhar Dist., the only source of drinking water to the 400 villagers. The well goes dr from February onwards

Groundwater quality studies for EIA for Reliance Petroleum Ltd., Jamnagar, Gujarat

This is a collaborative project with NEERI, Nagpur and involves development and analysis of technological options in case of contamination of groundwater by any one of the chemicals with the help of mathematical modelling.

Investigations were undertaken to define the geology and hydrogeology of the local area and assessment of present status of water quality of groundwater and near by surface water. Eventually demarcation of contamination zone likely to be influenced by the chemicals of hazardous waste of dump and leachets from the proposed dumping site is aimed at.

The water samples collected from the field have been analysed for various parameters. The total dissolved solids (TDS) and Chloride concentrations are the most important from the point of view of salinity. The TDS increases in NNW direction where sea water intrusion is prominent in the upper aquifer. Similarly TDS mounds are also observed west of Motikhavadi village where two prominent ridge dykes are crossing each other. To understand the contaminant behaviour of the proposed refinery at the study area a two-dimensional contamination model was prepared. The model inputs include hydrogeological parameters, effective porosity distribution, background concentration, probable sources and strengths of pollutants. The model output included areal and temporal distribution of water quality in aquifer.

Groundwater quality studies for comprehensive EIA of proposed hazardous waste disposal site at Mannellure, Tamilnadu

The project is taken up with collaboration of NEERI, Nagpur and involves development and analysis of technological options in case of contamination of groundwater by any one of the chemicals with the help of mathematical modelling. The study area is covered by lateritic and calcareous sedimentary formations of quarternary period. This formation is followed by a sandy aquifer of tertiary period at a depth.

A three dimensional finite difference groundwater model is applied to the study area. In this model the inter stream region between two nalas passing below and above Mannellure village have been considered as boundaries on south, east and north sides. And an imaginary boundary from Satyaveedu village to Egmmadurai village is considered as western boundary. The first aquifer i.e. the unconfined aquifer having about 8m thickness and the bottom aquifer of 30m thickness is considered for modelling. The model output indicates that the groundwater position in the study area.

To understand the leachate migration below the proposed site a two-dimensional contamination model was prepared. The model inputs include hydrogeological parameters, effective porosity distribution, background concentration, probable sources and strengths of pollutant. The model output included areal and temporal distribution of water quality in aquifer.

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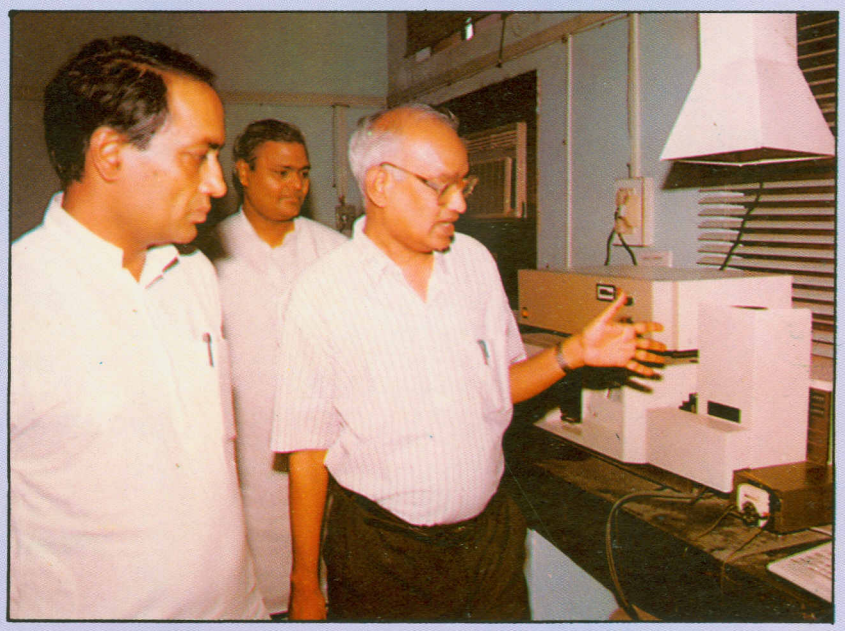
Appendices



APPENDIX-1

RESEARCH COUNCIL

Dr. P. Rama Rao Secretary, Govt. of India, Department of Science & Technology, Technology Bhawan, New Mehrauli Road, New Delhi-110 016.	**Chairman**
Shri A. Palit General Manager National Thermal Power Corpn., R&D Centre, A-8A Sector 24, Noida-201 301.	**Agency/Deptt. Rep.**
Dr. B.K. Sarkar Director, Central Glass & Ceramic Research Instt., P.O. Jadavpur University, Calcutta-700 032.	**Sister-Lab.**
Shri C.P.S. Nair C/o Dr. S. Unnikrishnan, Vrindavan, C.P. Gopala Panicker Lane, Sasthamangalam, Thiruvananthapuram-695 010.	**Expert**
Dr. D.N. Misra Vice-Chancellor, Benaras Hindu University, Varanasi-221 005.	**DG's Nominee**
Shri H.A. Ghanekar Executive Director, Bharat Heavy Electricals Limited, Piplani, Bhopal-462 022.	**Expert**
Shri N.S. Sethi Chief Secretary, Govt. of Madhya Pradesh, Vallabh Bhawan, Bhopal.	**Agency/Deptt. Rep.**
Dr. S.L.N. Acharyulu Director, Defence Metallurgical Research Lab., P.O. Kanchanbagh, Hyderabad-500 258.	**Expert**

Dr P Rama Rao, Secretary DST, chairing Research Council Meeting

Dr. T.N. Gupta — **Agency/Deptt. Rep.**
Executive Director,
Building Materials & Technology
Promotion Council (BMTPC),
G Wing, Nirman Bhawan,
New Delhi-110 011.

Prof. T.R. Ramachandran — **Expert**
Director,
Jawaharlal Nehru Aluminium Research
Development and Design Centre,
Opp. Wadi Police Station,
Amravati Road, Wadi,
Nagpur-440 023.

Shri Y.P. Dhawan — **Expert**
General Manager (Raw Materials),
Tata Iron & Steel Company Limited,
Jamshedpur-831 001.

Prof. T.C. Rao — **Member (Ex-Officio)**
Director,
Regional Research Laboratory,
Hoshangabad Road,
Bhopal-462 026.

Dr. R.N. Yadava — **Secretary**
Scientist EII,
Regional Research Laboratory,
Hoshangabad Road,
Bhopal-462 026.

The Research Council for RRL, Bhopal has been reconstituted for a period of three years effect from 1.7.1994.

During 1994-95 Tenth and Eleventh Meetings of the RC were held on April 16, 1994 and Octob 1994 respectively.

APPENDIX-2

MANAGEMENT COUNCIL

Prof. T.C. Rao Director, Regional Research Laboratory, Bhopal-462 026.	**Chairman**
Dr. A.D. Bhide Scientist, National Environmental Engg. Research Inst. Nehru Marg, Nagpur-440 020.	**Member**
Dr. A.K. Dubey Scientist CMRI Regional Centre CBRI Roorkee - 247 667	**Member**
Shri S.K. Bose Scientist, Regional Research Laboratory, Bhopal-462 026.	**Member**
Shri P.D. Ekbote Scientist, Regional Research Laboratory, Bhopal-462 026.	**Member**
Dr. (Ms.) Mohini Saxena Scientist, Regional Research Laboratory, Bhopal-462 026.	**Member**
Shri J. Prabakar Scientist, Regional Research Laboratory, Bhopal-462 026.	**Member**
Sr. Finance & Accounts Officer Regional Research Laboratory, Bhopal-462 026.	**Member**
DGSIR or his Nominee CSIR Headquarters New Delhi-110 001.	**Permanent Invitee**
Controller of Administration Regional Research Laboratory, Bhopal-462 026.	**Member Secretary**

During 1994-95 Sixteenth, Seventeenth and Eighteenth meetings of the MC were held on May 3, 1994, October 6, 1994, and February 23, 1994 respectively.

APPENDIX

DISTINGUISHED VISITORS

Shri Anna Sahib Hazare, Adarsh Gaon Yojana, Pune.

Shri A.K. Ahuja, Jt. Manager, Warship Bldg. (Welding), Mazagaon Dockyard, Bombay.

Prof. A.K. Chakraborty, Dept. of Metallurgical Engg., IIT, Kharagpur.

Dr. A.K. Nandi, Scientist, JNARD&DC, Nagpur.

Prof. A.K. Patwardhan, Dept. of Met. Engg., University of Roorkee.

Shri A.N. Mitra, Sr. Divisional Manager, TISCO.

Smt. Anita Das, Consultant, Unicef, Bhopal.

Shri A.P. Sahu, General Manager, M.P. State Mining Corpn., Bhopal.

Prof. A. Rahman, Former Director, NISTADS, New Delhi.

Shri Arun Gupta, Principal Secretary, Rural Development, Govt. of M.P.

Shri Arvind Joshi, Chairman-cum-Managing Director, M.P. Hasthashilp Vikas Nigam, Bhopal.

Prof. A.S.R. Sai, Dept. of Civil Engg. IIT, Kanpur.

Shri Badal K. Das, Secretary, PHED, Govt. of M.P.

Shri B.C. Misra, Chairman, CMPDIL, Ranchi.

Prof.(Dr.) Bernd Kieback (Material Sciences), German delegate from Fraunhofer Gasellschaft.

Shri Bhagirath Prasad, Commissioner, Bhopal Division and Chairman, Tawa Ayacut Developme Authority, Bhopal.

Shri Ch. V.G.K. Murthy, Manager (R&D), TISCO.

Shri Digvijay Singh, Chief Minister, Madhya Pradesh.

Shri D.K. Jain, General Manager, CMPDIL, Ranchi.

Dr. D.P. Rao, Head, IMSD, NRSA, Hyderabad.

Prof. D. Rupaniwar, Dept. of Applied Chemistry, Institute of Technology, BHU, Varanasi.

Prof. G.K. Sharma, Dean, IIT, Bombay.

Dr. G. Singh, Addl. Director General (Engg), ICAR, Delhi.

Dipl.-Ing. Heinrich Gottlob, Director, Siemens Matsushita Components GmbH & Co.Kg, Capacito Division, Heidenheim (Brenz).

Prof.(Dr.) H.S. Ray, Director, RRL, Bhubaneswar.

Dr. I.G. Reddy, Managing Director, Andhra Pradesh Industrial Development Corporation, Hyderaba

Dr. I.H. Siddiqui, Sr. Dy. General Manager, Deptt. of Civil, BHEL, Bhopal.

Shri I.S. Rao, Principal Secretary, Tribal Welfare Dept, Govt. of M.P.

Prof. J.S.R. Murthy, Dept. of Civil Engg. IIT, Bombay.

Dr. K.D. Sharma, Group Head, CAZARI, Jodhpur.

Shri K.R. Datye, Centre for Applied Systems Analysis in Development (CASAD), Bombay.

Shri K.T. Chacko, Secretary, Rural Development, Govt. of M.P.

Shri M.A.A. Parwaiz, DGM, NTPC, Rihandnagar.

Dr. M.L. Gupta, Group General Manager, Rajasthan State Mines & Minerals.

Prof. M.M. Sharma, Director, UDCT, Bombay and Member CSIR Society.

Shri M.N. Buch, former Secretary, Govt. of M.P.

Dr. M.N. Kulkarni, Chief, Field Office, UNICEF M.P. Office, Bhopal.

Prof. M. Ramamurthy, Director General, CPRI, Bangalore.

Prof. N. R. Iyengar, Director, Central Building Research Institute, Roorkee.

Mrs. Nirmala Buch, former Chief Secretary, M.P.

Shri Nguyen Gia Hung, Visiting Scientist, Vietnam.

Shri N.S. Sethi, Chief Secretary, M.P.

Shri P.J. Ingle, Addl. Director, CPRI, Bhopal.

Dr. P.K. Lahiri, Managing Director, M.P. Consultancy Organisation Ltd., Bhopal.

Prof. P.K. Rohatgi, former Director of RRL Bhopal and presently Director, Solidification, Composites, and Technology Labs of University of Wisconsin, USA.

Dr. P.R. Ramachandra Rao, Director, NML, Jamshedpur.

Dr. Ram Prasad, Director General, MPCOST, Bhopal.

Dr. R.K. Celley, Chief, Technology Marketing, BMTPC, New Delhi.

Dr. R.S. Devnani, Director, CIAE, Bhopal.

Prof. S. Aggarwal, Dept. of Metallurgical Engg., Faculty of Technology & Engg., Baroda.

Shri S.A. Wahid, Project Officer, UNICEF M.P. Office, Bhopal.

Shri Subrato Sinha, Bhartiya Gyan Vigyan Samiti, Calcutta.

Dr. Shyam S. Rao, Leader, Ceramics R&D, M/s WIDIA (I) Ltd., Bangalore.

Dr. S.K. Joshi, Director General CSIR, New Delhi.

Dr. S.K. Moothedath, Principal Scientist, INDAL, Belgaum.

Shri S. Rangnekar, Management Expert, Rangnekar Associates, Bombay.

Dr. S.R. Valluri, Chairman, TAB (Engg.), CSIR and former Director NAL.

Shri Sunjoy Joshi, Mission Director, Rajiv Gandhi Mission for Watershed Development, Govt. of M.P.

Shri Suresh Jain, Director, Bhopal Gas Tragedy Relief and Rehabilitation Dept., Bhopal.

Dr. T.V.S.R. Appa Rao, Scientist (Director's Grade), SERC, Madras.

Prof. V.C. Joshi, Dept. of Ceramic Engg., Institute of Technology, BHU, Varanasi.

Shri Vilas Rao Salunke, Pani Panchayat, Pune.

Dr. Vinay Dharmadhikari, Sr. Director (R&SA Div.), Govt. of India, Department of Electronics, New Delhi.

Dr. V.M. Sharma, Director, Central Soil Material Research Station New Delhi.

27th Shanti Swaroop Bhatnagar Memorial Tournaments at RRL, Bhopal Nov. 12–14, 1994

Dr S K Joshi, Director General, CSIR meeting a team

Shri J H Siddiqui, Sr DGM and Town Administrator BHEL at inaugural Volley ball match

Mrs Joshi gave away the prizes and mementoes

Mrs Joshi receiving a memento from Prof T C Rao

APPENDIX-4

RESEARCH PAPERS AUTHORED BY RRL SCIENTISTS

1. **P.A. Verghese and T.C. Rao**, "Modelling of a 76 mm diameter dense medium cyclone", Coal Preparation, 15, 71-91, 1994.
2. **R.N. Yadava, Arati Roy and Raj Kishor Katiyar**, "The effect of internal pressure on a penny-shaped crack at the interface of two bounded dissimilar micropolar elastic half-spaces", International Journal of Fracture, 65, 19-30, 1994.
3. **Rawlley R.K.**, "Mineralogical investigations on an Indian glauconitic sandstone of Madhya Pradesh State", Applied Clay Science, 8, 449-465, 1994.
4. **Govindarajan and T.C. Rao**, "Modelling and performance studies on Vorsyl Separator", Metals, Materials and Processes, 6 (1), 31-38, 1994.
5. **Govindarajan and T.C. Rao**, "Indexing the washability characteristics of coal", International Journal of Mineral Processing, 42, 285-293, 1994.
6. **Govindarajan and T.C. Rao**, "A simple equation for sink-float data", Minerals Engineering, 7 (11), 1441-1446, 1994.
7. **Dasgupta and S.K. Bose**, "Variation in magnetic properties of hard ferrites prepared from blue dust of Bailadila, M.P. with the initial raw material composition", Indian Journal of Pure and Applied Physics, 32, 96-97, 1994.
8. **K. Prasad, O.P. Modi and A.K. Jha**, "The influence of Al_2O_3 fibres on the sliding wear behaviour on an Al (LM5) alloy", Tribology International, 27, 153-158, 1994.
9. **B. Raju, S. Verma and T.C. Rao**, "Synthesis of in-situ SiAlON whisker reinforced ceramic composite — A new process", Convention 94 : Novel Synthesis and Processing of Ceramics, British Ceramic Soc. Proc., No.53, 1994.
10. **Navin Chandra, Jayant Konar, S.S. Amritphale and V.S. Muneshwar**, "Effect of aluminium addition in white cast iron on corrosion rate in Aqueous solution", J. Electrochem. Soc. India, 43-3, 1994.
11. **Kujur, J. Konar, S.S. Amritphale**, "Determination of total phosphorus in rock phosphate minerals by a modified faster titrimetric method", J. Silicate Industries, 1-2, 1994.
12. **K. Prasad**, "Structure-property related changes in a hypoeutectic aluminium-silicon alloy induced by solutionizing", Materials Transactions of Japan Institute of Metals, 35, 873-878, 1994.
13. **B. Singh, G. Venkatachari and K. Balakrishnan**, "Electrochemical studies on the oxidation behaviour of iron in $NaNO_3$-$NaNO_2$ melt", Corros. Sci., 36, 1777-1787, 1994.
14. **Das, A.K. Jha, B.K. Prasad, O.P. Modi and A.H. Yegneswaran**, "Microstructure and wear of Al-alloy matrix composites", Proc. Conf. Industrial Tribology, New Delhi, 1995.
15. **C. Rao and B. Govindrajan**, "Modelling studies on fine coal treatment processes", Monograph, Mineral Resources — Characterisation and Beneficiation, Wiley Eastern Ltd., 250-263, 1995.
16. **K. Rao, C. Padmakar and L.S. Rao**, "Petrographic liberation studies of glauconitic sandstone of Majhgawan area, Satna district, M.P.", The Indian Mining & Engg. Journal, 34 (1), 10-14, 1995.
17. **S. Rao and T.C. Rao**, "Upgradation and utilization of glauconitic sandstone as mineral fertilizer", The Indian Mining & Engg. Journal, 34 (1), 19-22, 1995.

APPENDIX-5

PAPERS PRESENTED BY RRL SCIENTISTS

1. **S.P. Pathak, S.S. Amritphale and Navin Chandra**, "Preparation of active manganese dioxide using microwave heating", Fifth National Convention of Electrochemists organised by SAEST, Karaikudi, CECRI, Karaikudi and University of Delhi at Delhi, April 5-6, 1994.
2. **H. Yegneswaran and B.K. Prasad**, "Case Studies in surface engineering : mining and farm implements" in Five Regional Workshops on Surface Modification Technologies and their industrial applications, organised by NFTDC-TIFAC at Ahmedabad, Bangalore, Pune, Madras and Jamshedpur respectively, on July 7, July 22, Aug. 4, Aug. 16 and Sept.1, 1994.
3. **Mohini Saxena, Arati Roy, Sulbha Amlathe and Rupa Dasgupta**, "Development aspects for women tribes of Patalkot valley, Chhindwara district, M.P.", State level workshop on Tribal women of Madhya Pradesh organised by CRDE & Tribal Development Dept., M.P. at Academy of Administration, Bhopal, Aug. 31- Sept. 2, 1994.
4. **A.K. Jha**, "Erosion-corrosion behaviour of aluminium alloy based composites", Int. Conf. on Erosion by Solid Particle Impact, Cambridge, UK, Sept. 4-8, 1994.
5. **Navin Chand**, "FRP products", CSIR-NSIC-APCTT Conference, Indore, Sept. 6, 1994.
6. **Navin Chand**, "Plastics in Agriculture and environment - A review", FICCI-IPI Conference, Sept. 7-8, 1994.
7. **Navin Chand**, "Effect of plasma treatment on fibres on properties of carbon fibre/PPS composite tape carbon, 1994.
8. **S. Das**, "Metal matrix composites - potential material for automobile applications", Workshop on To Assist the Small Scale Industries on Technology Acquisition and Monitoring at Indore, Sept. 7-8, 1994.
9. **P. Narayan, A. Roy, K. Basu, B.N. Das and N.C. Koon**, "Effect of strain rate on the hot deformation of Nd-Fe-B magnets", Rare Earth Magnets XIII Workshop in Birmingham, UK, Sept. 12, 1994.
10. **P. Narayan, V. Jayaram, K. Basu, B.N. Das and N.C. Koon**, "Preferred texture in hot deformed Nd-Fe-B magnets", TMS Materials Week 1994 in Chicago, USA, Oct.2 1994.
11. **Rawlley R.K.**, "Direct acid leaching of glauconitic sandstone for its potash values", International Symposium on Mineral Beneficiation — Recent Trends and Beyond 2000 AD at IBM, Nagpur, Oct. 3-5, 1994.
12. **Sanjeeva Rao. L and Bandopadhyay. P.**, "Treatment of fine coal washing rejects by oil agglomeration", ibid.
13. **R. Rao, D.P. Patil, J.P. Barnwal and T.C. Rao**, "Palm Rosa oil — A New collector for coal flotation", ibid.
14. **U. Bhaskar, J.P. Barnwal, M.R. Jhaku and T.C.Rao**, "Reduction of graphite carbon from lead rougher concentration using MGS", ibid.
15. **Prasad, A.K. Majumdar, G.M. Rao and T.C. Rao**, "Low grade dolomite rock phosphate Madhya Pradesh — A possible source for fertilizer industry", ibid.
16. **A.R. Hashmi, S. Horiuchi and T. Kitano**, "Distribution of carbon fibre in the ternary blend matrix of Epoxy/Polymer Sulphone/NBR", 43rd Macro-molecule Conference in the Foreign Researcher and Student Forum at Kyushu University, Japan, Oct. 13, 1994.

17. **A.R. Hashmi**, "Research activities in CSIR with special reference of RRL, Bhopal", 43rd Macro-molecule Conference in the Foreign Researcher and Student Foru at Kyushu University, Japan, Oct. 13, 1994.
18. **Mohini Saxena**, "Utilisation of natural fibres", at International Scientific Collaboration, CSIR, Jan.5, 1995.
19. **Venkateswarlu and S. Das**, "X-Ray diffraction analysis of flyash using PC-APD software", National Workshop on Flyash Utilisation, at RRL, Bhopal, Jan. 11-12, 1995.
20. **Verma, K. Srinivas, C.B. Raju and A.H. Yegneswaran**, "Advanced structural ceramics from flyash", ibid.
21. **Mohini Saxena, P. Ashokan, S. Shrimanth, Aparna Chauhan, Sangita Mondal and R.B. Pathak**, "Ash utilisation for land reclamation at Nilgiri site NTPC Rihandnagar", ibid.
22. **Mohini Saxena, P. Ashokan, Sangita Mandal, S.K. Bose and A.C. Khazanchi**, "Fly ash lechate characteristics and its application in wasteland development", ibid.
23. **Mohini Saxena, R.K. Morchhale and S.R. Karade**, "Development of flyash polymer composite - an alternate to wood", ibid.
24. **R. Karade, R.K. Morchhale, Mohini Saxena and A.C. Khazanchi**, "Flyash utilisation with Indian Soils for making bricks", ibid.
25. **Ashokan, Mohini Saxena, S.K. Bose and A.C. Khazanchi**, "Reactivity of ash in black cotton soil for agricultural application", ibid.
26. **Prabakar, R.S. Ahirwar, M. Saxena and S.K. Bose**, "Application of flyash in building construction", ibid.
27. **Asokan, Mohini Saxena, S. Shrimanth, Sangita Mandal, Aparna Chauhan and R.B. Pathak**, "Ash Utilisation for soil amendment at Dodhar village NTPC Rihandnagar", ibid.
28. **Sangita Tiwari, Mohini Saxena, A.K. Basu and J.M. Modawel**, "Development of paints using flyash as filler", ibid.
29. **Sorna Gowri and Mohini Saxena**, "Enhancement of durability of bamboo using flyash based coatings", ibid.
30. **Aparna Chauhan and Kiran Singh**, "Uptake of cadmium by bacillus subtilis strains - a flyash isolate", ibid.
31. **S. Amritphale and Navin Chandra**, "Effect of a complex activator on sintering behaviour of pyrophyllite-fly ash compositions", ibid.
32. **K. Morchhale and M. Saxena**, "Red mud polymer composite - a promising wood substitute material", Entrepreneurs Development, organised by MAPCET at MACT, Bhopal, Jan. 14, 1995.
33. **R. Karade, R.K. Morchhale and M. Saxena**, "Clay fly ash bricks", ibid.
34. **J. Prabakar and R.S. Ahirwar**, "Development of alternate building material", ibid.
35. **Ranjit Singh Solanki and V.S. Muneshwar**, "Residual life prediction of welded structures - a specific approach", Workshop arranged by CBIP at RSEB, Kota, Jan. 16-22, 1995.
36. **Ranjit Singh Solanki**, "The significance of flaws related to welding operation", ibid.
37. **Ranjit Singh Solanki**, "An introduction to residual stress in weld joints", ibid.
38. **Ranjit Singh Solanki**, "Welding - a fundamental process for joining the materials", ibid.
39. **Ranjit Singh Solanki**, "Weldability assessments - an experimental approach", ibid.

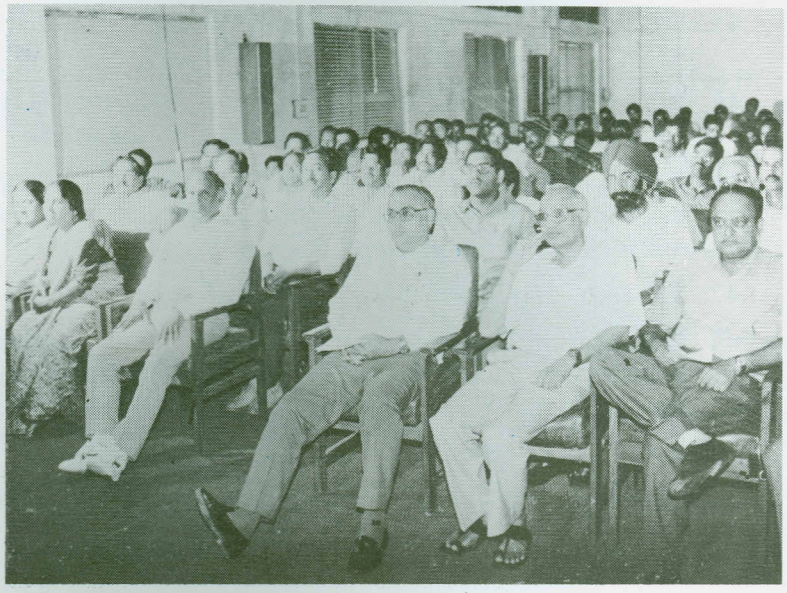
40. **Ranjit Singh Solanki**, "Materials for high temperature applications in fossil-fuel-fired power stations", ibid.
41. **Ranjit Singh Solanki**, "Optimisation of distortion in welded structures - a case study", ibid.
42. **S. Das, A.K. Jha, B.K. Prasad, O.P. Modi and A.H. Yegneswaran**, "Microstructure and wear of aluminium alloy matrix composites", XI National Conference on Industrial Tribology, New Delhi organised by Tribology Society of India, Hyderabad, Jan. 22-25, 1995.
43. **L.C. Mohan**, "Foundry waste slag utilisation", Technical Seminar of IIF Bhopal Chapter at Bhopal, Jan. 30, 1995.
44. **L.C. Mohan, C.N. Pathak and A.K. Gupta**, "Production of glass ceramics from foundry slag", 43rd IFC at Jamshedpur, Feb. 3- 5, 1995.
45. **R.K. Morchhale** "Possibilities of utilization of NALCO red mud with polymer matrix for wood substitute", at NALCO, Bhubaneshwar, Feb. 23, 1995.
46. **T.C Rao, B. Govindarajan and J.P. Barnwal**, "A simple model for industrial coal flotation operation", SME Conference on High Efficiency Coal Preparation, Denver, USA, March 6-7, 1995.
47. **T.C Rao**, "High efficiency coal preparation", ibid.
48. **R.K. Morchhale**, "Red mud polymer doors", Workshop on Identification of Thrust Areas of Science and Technology Inputs in Madhya Pradesh Regarding Various Technologies at MACT, Bhopal, March 25-26, 1995.
49. **A.K. Gupta**, "Dokra craft", ibid.
50. **M. Saxena, A. Roy, S. Amlathe and R. Dasputa**, "Handicraft items from sisal fibres", ibid.
51. **M. Saxena, A. Roy, S. Amlathe and R. Dasputa**, "S&T inputs in the life of tribal women of M.P.", ibid.
52. **A.K. Jha, B.K. Prasad, O.P. Modi, S. Das and A.H. Yegneswaran**, "Improvement in the quality of tillage implements through metallurgical studies", ibid.
53. **R. Dasgupta, S.P. Narayan and S.K. Bose**, "Utilization of blue-dust of Biladila, M.P. as a starting material for producing hard ferrite", ibid.
54. **M. Saxena, P. Asokan, S. Srimanth**, "Industrial waste utilisation for wasteland development", National Symposium on Plantation in Wasteland organised by Natural Resource Development Corpn., Bhubaneswar at CSIR, Delhi, March 6, 1995.

APPENDIX-6

LECTURES

Invited Lectures experts

Prof. M.M. Sharma, Director, UDCT, Bombay, "Polymers-The Emerging Materials", CSIR Foundation Day Address.



Prof M M Sharma, Director, UDCT, Bombay, delivered CSIR Foundation Day address on "Polymers the emerging materials"

Dr. Shyam S. Rao, Leader, Ceramics R&D, M/s WIDIA (I) Ltd., Bangalore, "Hightech cutting tool materials" and "Micro-Raman characterisation of residual micro-stresses in SiC-reinforced glass composites".

Prof. G.K. Sharma, Dean, IIT, Bombay, "Energy conservation in industrial plants".

Dr. S.R. Valluri, Chairman, TAB (Engg.), CSIR and former Director NAL, "Economic liberalisation : Challenges for science, technology and industry" and "On the need for a code of ethics for the practice and management of science in India".

Shri G.R. Rao, IIT, Kharagpur, "Study of fracture toughness in non-neutral environment".

Dr. I.G. Reddy, Managing Director, Andhra Pradesh Industrial Development Corporation, Hyderabad, "Commercialisation of new technologies".

Shri S. Rangnekar, Managing Expert, Rangnekar Association, Bombay on "Management for results in research laboratories".

Shri K.N. Gupta, Dy. Director, NML, Jamshedpur on "Activities of NML".

Dr. H.K. Khaira, Asstt. Professor, MACT, Bhopal on "Non- destructive testing" in IIF Bhopal Chapter meeting.

Dr. A. Sarkar, Asst. Professor & Head, Dept. of Applied Chemistry, Indian School of Mines, Dhanbad on "Fourier transform infrared spectroscopy and application in coal structure determination".

Prof.(Dr.) H.S. Ray, Director, RRL, Bhubaneswar on "Nickel".

Lectures delivered by RRL Staff

R.S. Ahirwar, "Low cost housing in urban and semi-urban areas under Nehru Rozgar Yojna" at Academy of Administration, Bhopal.

Dr. S. Das, "Metal matrix particle composites - potential material for brake drum applications" at TELCO, Jamshedpur.

Dr. S. Das, "SLIZ : a potential material for bush bearing" at TELCO, Jamshedpur.

Dr. B.K. Prasad, "R&D activities at RRL Bhopal" at CMPDIL, Ranchi.

Dr. O.P. Modi, "Coal petrography and analysis of minor and trace toxic elements" at CMPDIL, Ranchi.

S.P. Narayan, "Influence of strain rate on the magnetic properties of hot deformed Nd-Fe-B compound", at Naval Research Laboratory, Washington, USA.

Dr. A.K. Jha, "Aluminium alloy based composites : a potential material for tribological applications" at (1) Department of Material Science & Metallurgy, University of Cambridge on Sept. 7, 1994 and (2) Department of Materials Technology, Brunel University, UK.

S.P. Narayan, "Hot deformation studies on Nd-Fe-B magnets and effect of strain rate on magnetic anisotropy" at National Physical Laboratory, London, UK.

Dr. O.P. Modi, "R&D activities and highlights of achievements at RRL, Bhopal" at BHEL, Tiruchirapalli.

Dr. O.P. Modi, "Petrographic analysis of coal" at BHEL, Tiruchirapalli.

S.A.R. Hashmi, "Research activities in CSIR (India) with special reference of RRL, Bhopal" on the occasion of 43rd Macromolecule Conference in the Foreign Researcher and Student Forum at Kyushu University, Japan.

Dr. Mohini Saxena, "Utilisation of fly ash for fertility of Barren land" at Wasteland Development Board.

S. K. Bose, "R&D activities on Building Materials Division" at Building Centre, Barasia Road, Bhopal.

Ranjit Singh Solanki, "Welding technology", at RSEB, Kota Thermal Power Station arranged by CBIP.

S. K. Bose, "Red mud cementitious binder - waste to a value added product at National Metallurgical Laboratory, Jamshedpur.

S.K. Bose, "Madhya Pradesh ke khanij sansadhanon ka udyog me upayog ki sambhavana" at AIR, Bhopal.

Dr. Kunal Basu, "Role of RRL in S&T development of M.P.", Workshop on Identification of Thrust Areas of Science and Technology Inputs in Madhya Pradesh Regarding Various Technologies at MACT, Bhopal.

* * *

APPENDIX-7

SEMINARS/WORKSHOPS/CONFERENCES ATTENDED BY RRL STAFF

1. **Dr. S.S. Amritphale** attended the Fifth National Convention of Electrochemists organised by SAEST, Karaikudi, CECRI, Karaikudi and University of Delhi at Delhi, April 5-6, 1994.
2. **Prof. T.C. Rao, Dr. R.N. Yadava and P.D. Ekbote** attended the meeting of PME Scientists of CSIR labs held at CSIR Science Centre, New Delhi, April 29-30, 1994.
3. **Dr. R.N. Yadava** chaired the Workshop on Groundwater Recharge, Vikram Gyan Mandir, Dhar, May 26, 1994.
4. **S.P. Narayan** participated as delegate in The Sixth MMM-Intermag Conference in Alberquerque, at New Mexico (USA), June 20-23, 1994.
5. **Dr. A.H. Yegneswaran, Dr. B.K. Prasad, Ranjit Singh Solanki, Dr. A.K. Gupta and Dr. O.P. Modi** attended in the Regional Workshops on Surface Modification Technologies and their industrial applications, organised by NFTDC-TIFAC at Ahmedabad, Bangalore, Pune, Madras and Jamshedpur respectively, July 7, July 22, Aug. 4, Aug. 16 and Sept. 1, 1994.
6. **Prof. T.C. Rao, Director, Shri G. Simhachalam, COA, Shri E. Nagarajan, SFAO, Dr. Kunal Baso, Shri S.K. Bose, Shri B.K. Saxena, Dr. R.N. Yadava, Dr. Navin Chandra, Dr. C.B. Raju,** Scientists attended the Workshop on Management of Change, MACT Bhopal, Aug. 1, 1994.
7. **Dr. R.N. Yadava** attended Technical meet on Land and water systems analysis, "Groundwater resources management through modelling in the Tawa canal command area, Hoshangabad district, M.P.", Aug. 17-18, 1994.
8. **Dr. Navin Chand and Dr. S. Das** attended Workshop To assist the small scale industries on technology acquisition and monitoring, Indore, Sept. 7-8, 1994.
9. **Dr. A.K. Jha** attended Conference on Powders and Sintering, Manchester, Institution of Materials, UK, Sept. 15-16, 1994.
10. **Dr. A.K. Jha** attended Symposium Advanced Materials in the Market Place, University of Surrey, UK, Sept. 22, 1994.
11. **Prof. T.C. Rao, Dr. J.P. Barnwal, Dr. R.K. Rawlley, A.K. Majumdar, Murari Prasad, Dr. D.P. Patil, L.S. Rao, K. Udaya Bhaskar** attended the International Symposium on Mineral beneficiation — Recent trends and beyond - 2000 AD, IBM Nagpur, Oct. 3-5, 1994.
12. **S.A.R. Hashmi** attended the 43rd Macromolecules Conference at Kyushu University, Japan, Oct. 13, 1994.
13. **Dr. A.K. Jha** attended the Regional Conference on Efficient Utilisation on Animal Energy in Rural Development held at CIAE, Bhopal, Oct. 21-22, 1994.
14. **S.A.R. Hashmi** attended the International Symposium on Fibre Science and Technology at Yokohama, Japan, Oct. 26-28, 1994.
15. **S.A.R. Hashmi** attended the Third International Conference on Plastic Optical Fibres and Applications at Yokohama, Japan, Oct. 26-28, 1994.
16. **Dr. A.H. Yegneswaran and D.P. Mondal** attended 32nd NMD and 48th ATM of IIM at Visakhapatnam, Nov. 14-17, 1994.
17. **Dr. T.C. Rao** participated Seventh National Conference on in-house R&D in industry organised by DSIR and Federation of India Chambers of Commerce and Industry, New Delhi, Nov. 26-27, 1994.

Appendices

18. **Dr. (Ms.) Rupa Dasgupta and R.S. Solanki** attended Intensive course on Coating technology, "COATTECH-94", organised by IIM Bombay Chapter and Institution of Engineers, Maharashtra Chapter at Bombay, Dec. 7-9, 1994.
19. **Dr. R.N. Yadava** attended District level Workshop on Rural Sanitation, Dhar, Dec. 19-20, 1994.
20. **J. Prabakar** attended Seminar on Engineering Structures Mitigating Damages due to Cyclones at SERC, Madras, Jan.4-6, 1995.
21. **Dr. A.H. Yegneswaran** attended the meeting of working group on life estimation thermal power station at CBIP, New Delhi, Jan. 5, 1995.
22. **S.K. Bose, Dr. Navin Chandra, Dr. A.H. Yegneswaran, Dr.(Ms.) M. Saxena, Dr. S.S. Amritphale, Dr. A.K. Jha, Dr. S. Das, Dr. O.P. Modi, Dr. B.K. Prasad, R.K. Morchhale, Dr.(Ms.) Rupa Dasgupta, J. Prabakar, R.S. Ahirwar, K. Venkateswarlu and S.R. Karade** attended the National Workshop on Fly ash Utilisation, organised by CBIP and RRL at RRL, Bhopal, Jan. 11-12, 1995.
23. **S.R. Karade** attended training programme on Brick Production Technologies at CBRI, Roorkee, Jan. 15-21, 1995.
24. **Dr. R.N. Yadava** attended National Seminar on Environment and Development of Process Industries, organised by Indian National Academy of Engg., New Delhi at Central Gujarat Chamber of Commerce, Baroda, Jan. 20-21, 1995.
25. **R.K. Morchhale** attended a National Seminar on the Role of Building Centres in Low Cost Housing, organised by HUDCO and MP Awas Vikas Sansthan at Bhopal, March 2, 1995.
26. **S.K. Bose and Dr.(Ms.) Mohini Saxena** attended a National Symposium on Plantation in Wasteland at Science Centre, CSIR, New Delhi, March 6, 1995.
27. **Dr. A.H. Yegneswaran, Dr. A.K. Jha, Dr. A.K. Gupta and Dr. B.K. Prasad** attended Regional Seminar on Agricultural Farm Machinery organised by ISAE/CIAE, Bhopal at CFMTTI, Budni, March 12, 1995.
28. **Prof. T.C. Rao, Dr. Kunal Basu, Dr. R.N. Yadava, Dr. A.H. Yegneswaran, Dr. C.B. Raju, Dr. Navin Chand, P.D. Ekbote, Dr. A.K. Gupta, Dr. J.P. Barnwal, Dr. B.K. Prasad, Shri M.S. Yadav, Dr. (Ms.) Rupa Dasgupta, Shri R.S. Ahirwar and D. Mondal** attended the Workshop on Identification of Thrust Areas of Science and Technology Inputs in Madhya Pradesh Regarding Various Technologies at MACT, Bhopal, March 25, 1995.

APPENDIX-8

STAFF NEWS

APPOINTMENT

B. Chakradhar	- Scientist EI
Mulayam Singh Yadav	- Scientist C on transfer from CEERI, Pilani
Dr. S.K. Sanghi	- Scientist C
B. Tirupati	- Scientist B
Raghuvanshi Ram	- Scientist B
Dr. I.B. Singh	- Scientist B on transfer from CECRI, Karaikudi
Sanjay Vinodiya	- Jr. Steno

ASSESSMENT

V.S. Muneshwar Gr.IV(1)	- Gr.IV(2)
Dr. R.K. Rawlley Gr.IV(1)	- Gr.IV(2)
R.K. Morchhale Gr.IV(1)	- Gr.IV(2)
A.K. Singh Gr.IV(1)	- Gr.IV(2)
S.A.R. Hashmi Gr.IV(1)	- Gr.IV(2)
Murari Prasad Gr.IV(1)	- Gr.IV(2)
S.P. Pathak Gr.IV(1)	- Gr.IV(2)
Dr.(Ms.) Rupa Dasgupta Gr.IV(1)	- Gr.IV(2)
L.C. Mohan Gr.IV(2)	- Gr.IV(3)
S.P. Narayan Gr.IV(2)	- Gr.IV(3)
R.S. Solanki Gr.IV(2)	- Gr.IV(3)
Dr. A.K. Jha Gr.IV(2)	- Gr.IV(3)
Dr. S. Das Gr.IV(2)	- Gr.IV(3)
Dr. O.P. Modi Gr.IV(2)	- Gr.IV(3)
Dr. A.H. Yegneswaran Gr.IV(3)	- Gr.IV(4)
Dr. C.B. Raju Gr.IV(3)	- Gr.IV(4)
J.P.Pandey Gr.III(1)	- Gr.III(2)
Rishi Kumar Karla Gr.III(1)	- Gr.III(2)
T.S.V. Chakradhar Rao Gr.III(1)	- Gr.III(2)
Ajay Kulsreshth Gr.III(1)	- Gr.III(2)
M.K. Jain Gr.III(1)	- Gr.III(2)
Narayan Saha Gr.III(2)	- Gr.III(3)
Madan Lal Gurjar Gr.II(1)	- Gr.II(2)
Akhtar Ullah Gr.II(1)	- Gr.II(2)
P.N. Patil Gr.II(1)	- Gr.II(2)

B.L.Pradhan Gr.I(1) - Gr.I(2)
L.N. Mehra Gr.I(1) - Gr.I(2)

VISITS ABROAD

S.A.R. Hashmi visited Japan to participate in Group Training Course in Polymer Science and Technology under Colombo Plan during June 26, 1994 to Jan. 29, 1995.

Dr. A.K. Jha visited UK under Bilateral Exchange programme of INSA and Royal Society of London for three months from July 15, 1994.

S.P. Narayan completed official deputation at Naval Research Laboratory, Washington, D.C. USA under Indo-US Science & Technology Fellowship programme in Jan. 1995.

Dr. S.K. Sanghi is currently on visit to University of Amsterdam, Netherlands under CEC project work for a period of six months from Jan. 16, 1995.

Prof. T.C. Rao visited USA to attend Symposium organised by SME in Denver, USA during March 6-9, 1995. He presented a paper and chaired a session in "High efficiency coal preparation" He also visited University of Utah, University of Illinois and delivered lectures.

MEMBERSHIPS, RECOGNITION, AWARD

Prof. T.C. Rao

- Convenor of the newly constituted TAB on Material Science & Technology.
- Member of reconstituted MRSI Council 1994.
- Elected as a Committee Member to The Institution of Engineers (India) M.P. State Centre Committee for the sessions 1994-95 & 1995-96.
- Member of Executive Council of Disaster Management Institute, Bhopal.
- Member of Society for Mining, Metallurgy and Exploration, Inc. (SME).
- Member SSRC, Dept. of Coal, Govt. of India
- Member empowered committee for Rajiv Gandhi Mission of Govt. of M.P.
- Member editorial board, Coal Preparation Journal
- Member editorial board, Int. J. Min. Processing

Dr. Navin Chand has been elected Fellow of The Institute of Materials, London on Nov.22, 1994.

Dr. A.H. Yegneswaran nominated in the Editorial Committee of Surface Engineering Journal.

Dr.(Ms.) Rupa Dasgupta nominated as Honorary Member of the *Bulletin of Pure and Applied Sciences*.

Dr. S. Das - Secretary, IIM Bhopal Chapter.

Dr. B.K. Prasad - Joint Secretary, IIM Bhopal Chapter.

Dr. A.H. Yegneswaran - Treasurer, IIM Bhopal Chapter.

L.C. Mohan - Hony. Secy., IIF, Bhopal Chapter.

Dr. Navin Chand received a BHEL citation for "Excellence in Science and Technology" in recognition of his outstanding contribution in the development of FRP gear case for locomotives.

Dr. R.N. Yadava has been awarded "Raman Research Fellowship" for study visit abroad in the area of "Geographical information system - Application to Water Resources Management" at Department of Geography & Environmental Studies Program, University of California, USA.

Dr. S. Das awarded "Best Presentation" in Applied research category and cash prize of Rs.1100/- for paper entitled "Microstructure and wear of aluminium alloy matrix composites", organised by Tribology Society of India, Hyderabad in XI National Conference on Industrial Tribology at New Delhi, Jan.22-25, 1995.

Mohammed Fahim, Project Fellow received the Young Scientist Award of M.P. Council of Science and Technology for a research paper "A theoretical model to control erosive wear of FRP components during Engineering and Industrial Applications". The work was done under the guidance of Dr. Navin Chand, Scientist.

HIGHER EDUCATION

B.K. Prasad awarded Ph.D degree from University of Roorkee, Roorkee.

Ms. Rupa Dasgupta awarded Ph.D degree from Barkatullah University, Bhopal.

S.R. Karade obtained M.Tech degree from MACT, Bhopal.

RETIREMENT

Shri B.K. Saxena, Scientist F retired on Superannuation on December, 1994.

APPENDIX- 9

STAFF LIST AS ON 31.3.1995

Prof. T.C. Rao, Director

BUILDING MATERIALS DIVISION

S.K. Bose, Scientist F & Head
Dr. Navin Chand, Scientist EI
Dr. Mohini Saxena, Scientist C
R.K. Morchhale, Scientist C
S.A.R. Hashmi, Scientist C
Alka Meshram, Scientist B
J. Prabakar, Scientist B
S. Srimanth, Scientist B
R.S. Ahirwar, Scientist B
P. Asokan, Scientist B
Ajay Kulshereshth, JSA
S.R. Karade, JTA
Ajay Naik, STA
Antony. V, Technician
S.K. Botham, Helper

METALLURGY & MATERIALS DIVISION

Dr. Kunal Basu, Scientist F & Head
Dr. Navin Chandra, Scientist EII
Dr. A.H. Yegneshwaran, Scientist EII
L.C. Mohan, Scientist EI
S.P. Narayan, Scientist EI
R.S. Solanki, Scientist EI
Dr. A.K. Jha, Scientist EI
Dr. O.P. Modi, Scientist EI
Dr. S. Das, Scientist EI
Dr. A.K. Gupta, Scientist C
Dr. B.K. Prasad, Scientist C
Dr. S.S. Amritphale, Scientist C
Mulayam Singh Yadav, Scientist C
V.S. Muneshwar, Scientist C
Dr. R.K. Rawlley, Scientist C
A.K. Singh, Scientist C
Dr. Rupa Dasgupta, Scientist C
S.P. Pathak, Scientist C
D. Mondal, Scientist B
Dr. I.B. Singh, Scientist B
K. Venkateswarlu, STA
J.P. Pandey, Gr.III(2)
T.S.V.C. Rao, Gr.III(2)
P.K. Rangari, JTA
U. Mukut Lakra, SLA
Ramesh Kosthi, SLA
R.K. Gurjar, Gr.II(2)
P.N. Patil, Gr.II(2)
A.K. Asati, Technician
Bharat Patil, Mechanic
M.L. Gurjur, Plumber
L.N. Mehra, Helper
L.N. Sahu, Helper
Indraj Yadava, Security Guard
G.B. Gurang, Security Guard

MINERALS DIVISON

Dr. C.B. Raju, Scientist EII & Head
B. Chakradhar, Scientist EI
Dr. J.P. Barnwal, Scientist C
Dr. B. Govindarajan, Scientist C
Dr. D.P. Patil, Scientist C
Murari Prasad, Scientist C
L. Sanjeeva Rao, Scientist B
A.K. Majumder, Scientist B
K. Udaya Bhaskar, Scientist B
B. Kujur, Gr.III(3)
P. Banerjee, SSA
Manoj Kumar Ban, JSA
Jayant Konar, JTA
K. Kosala Rao, JTA
B.L. Pradhan, Helper

RESOURCES DEVELOPMENT DIVISION

Dr. R.N. Yadava, Scientist EII & Head
P.D. Ekbote, Scientist EI
Dr. M.V.R.L. Murthy, Scientist C
Dr. Arati Roy, Scientist C
Dr. S.K. Sanghi, Scientist C
B. Tirupati, Scientist B
Raghuvanshi Ram, Scientist B

N. Saha, Gr.III(3)
Mini Surendran, Sr. Steno.
Devilal Rathore, Security Guard

ENGINEERING SERVICES DIVISION

B.K Saxena, Scientist F & Head (Retd. on 31.12.94)
K.K.S. Gautam, Scientist EI
R. Dubey, Asistant Executive Engineer
M.K. Jain, Jr. Engineer (Elect.)
R.K. Chauhan, STA
Manik Chandra, STA
P.C. Meshram, SLA
Akhtar Ullah, Electrician
S.K. Suryavanshi, Jr. Electrician
D.K. Singh, Mechanic (Elect.)
S.K. Raikwar, Helper

LIBRARY

Rishi Kumar, Gr.III(2)
Abhay Yadava, Gr.II(2)
Dayaram, Safaiwala

DIRECTOR'S OFFICE

T.P. Prasanan, PS
Manisha Dubey, Jr. Translator
Vishwanathan N., Sr. Steno.
Vishakha Ramteke, Jr. Steno.
R.N. Pradhan, Security Guard

ADMINISTRATION

G. Simhachalam, Controller of Admin.
B.N. Dikshit, Section Officer
Vinod Dahate, Section Officer
H.N. Rao, H. Lab. Supervisor
Shyamla Soman, Sr. Steno.
Sathi Vijayan, Sr. Steno.
D.M. Chilbule, S/P Asstt.
Swagatika Pal, Gr.II(1)
Asha Trivedi, LDC
Jaipal Kujur, LDC
C.V.B.Subramanian, LDC
Devtanand Prasad, Tea-maker
Md. Rafiq, Driver
Ramcharan Malvi, Driver
G.S. Yadav, Driver
Ram Kishore, Driver
Arun Saxena, Guest House Keeper
Vijay Golait, Messenger
Anil Gond, Messenger
K.P. Tripathi, Security Guard
G.D. Sootha, Cook-cum-Bearer

FINANCE & ACCOUNTS SECTION

E. Nagarajan, Sr. F&AO
S. Chandrahas, Section Officer (F&A)
Girish Chand, UDC
Anita Daniel, Receptionist
Sanjay Vinodiya, Jr. Steno.
N.K. Pethari, LDC
N.S. Jadav, Messenger

STORES & PURCHASE SECTION

Mukesh Khanna, Dy. SPO
S.K. Chaudhary, PS
R.N. Ram, Assistant
P.K.Satyanesen, UDC
R.N. Sharma, Record Keeper
Harihar Singh, Watchman

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